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Supplemental Environmental Impact Statement

OCS EIS/EA
MMS 89-0061

5–Year
Outer Continental Shelf Oil and Gas Leasing Program

Mid–1987 to Mid–1992

Draft

MMS U.S. Department of the Interior
Minerals Management Service

August 1989

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II

COVER SHEET

Supplemental Environmental Impact Statement
5-Year Outer Continental Shelf Oil and Gas
Leasing Program
Mid 1987 To Mid 1992

Draft Supplement(x) Final Supplement()

Type of Action:

Administrative(x) Legislative()

Area of Potential Impact:

Offshore Marine Environment and Coastal Counties of Alaska, California, Oregon, and Washington.

Responsible Agency:

U.S. Department of the Interior
Minerals Management Service
381 Elden Street
Herndon, VA 22070

Abstract:

This draft document supplements the final environmental impact statement prepared for the 5-Year (Mid-1987 to Mid-1992) Outer Continental Shelf (OCS) oil and gas leasing schedule. This document analyzes the cumulative impacts of OCS development on migratory species whose migration routes traverse more than one planning area in the Alaska and Pacific Regions. The analysis is based on the court's premise that the Secretary did not consider the effects of simultaneous inter-regional development on migratory species. It also describes and incorporates into the analysis the OCS oil and gas activities and non-OCS activities along those migration routes.

The overall cumulative impacts on migratory species could be caused by oil and gas activities, oil spills, effluent discharges, noise (aircraft and vessel traffic and human disturbances), loss of habitat, subsistence and sport hunting, and natural perturbations.

Coastal States which are considered in the analysis are: Alaska, Washington, Oregon, and California.

For further information regarding this statement, contact:

Debra Purvis
Branch of Environmental Evaluation
Minerals Management Service
381 Elden Street
Herndon, VA 22070
(703) 787-1674

Comments on this draft document are due on October 17, 1989. Comments should be addressed to the Branch of Environmental Evaluation (Mail Stop 644) at the above address. Public hearing on the draft supplemental environmental impact statement will be held in late September. The *Federal Register* notice on the availability of the document will announce the exact dates, time, and location of the public hearings.

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SUMMARY

SUMMARY

A. Introduction

On December 30, 1988, the U.S. Court of Appeals for the District of Columbia ruled that the final Environmental Impact Statement (EIS) for the Proposed 5-Year Outer Continental Shelf Oil and Gas Leasing Program, mid-1987 to mid-1992, failed to adequately analyze the cumulative impacts of the proposed leasing program on migratory species. The purpose of this document is to supplement the cumulative analysis in the final EIS so that the Secretary may determine whether changes to the current 5-year program are warranted.

The effects of the current 5-year program on migratory species in the Pacific and Alaska OCS Regions are analyzed in this supplemental EIS. Two alternatives to simultaneous development are also examined.

B. Alternative I - 1987 Program

Alternative I consists of a total of 38 sales that were scheduled in 21 of the 26 planning areas. Table II.B.1-3 indicates the cumulative impact levels of the 1987 program on migratory species in the Alaska and Pacific OCS Regions. The cumulative impact level takes into account the effects expected from non-OCS activities, existing oil and gas activities, as well as those from the 1987 program and future 5-year programs. The detailed impact analyses are included in Section IV.D.

Cumulative impacts to migratory species range from very low to high (Table II. B.II-3). Impact levels for the resources analyzed are defined in Appendix A. The current and future 5-year programs are expected to increase the impacts to migratory species in the Pacific and Alaska Regions to some extent above the impacts from existing activities. However, the incremental effects of the current and future 5-year programs are not expected to raise the overall impact level for any migratory species except the northern fur seal (see Section IV.D.2.c).

C. Alternative II - Defer Leasing in One or More Planning Areas

This alternative would defer leasing in one or more planning areas in the Alaska and Pacific Regions. The purpose for deferral is to avoid the simultaneous oil and gas development activities that were identified in Section IV.D. as causing impacts on one or more migratory species. It is assumed for this analysis that any planning area deferred under this alternative would also be deferred from leasing under future 5-year programs. Adopting this alternative eliminates the possibility that simultaneous development could occur in the Pacific and Alaska Regions as a result of the 5-year program.

Existing OCS and non-OCS activities are causing a moderate level of impact to the northern fur seal while the overall level of cumulative impacts with the addition of the current and future 5-year programs is expected to be high. The deferral of the development and transportation of oil resources within the St. George Planning Area during this and future 5-year programs would reduce the risk of contact to this localized northern fur seal population during periods of concentration. Therefore, this alternative would reduce the impacts to the northern fur seal from high to moderate. Impacts to other migratory species would remain at the same level as for Alternative I.

D. Alternative III - No Action

For the purpose of this analysis, this alternative assumes that the remaining lease sales in the current 5-year program within the Alaska and Pacific Regions will be deferred. This alternative would constitute the most extreme level of mitigation to eliminate simultaneous development.

Under this alternative the only Federal oil and gas activities in the Pacific and Alaska Regions would be from previously leased areas. Deferral of the remaining lease sales in the Pacific and Alaska Regions in the current 5-year program would reduce somewhat the impacts to migratory species. However, a comparison of the effects from existing activities and the current and future 5-year programs indicates that the 5-year program does not increase impacts to migratory species above impact levels from existing activities, with the exception of northern fur seals. Therefore, this alternative would be expected to reduce the overall impact to the northern fur seal from a high to a moderate level. The impacts to all other migratory species would remain at the same overall levels as indicated for alternative I.

The deferral of leasing in Pacific and Alaska Regions would also eliminate all potential impacts of exploration, development, and production activities on all components of the physical, biological, and socioeconomic environment within the planning area. Impacts to these resources which would be avoided by this alternative are analyzed in Section IV.B. of the FEIS for the current 5-year program.

CHAPTER I

PURPOSE AND NEED FOR THE ACTION

I. PURPOSE AND NEED FOR THE ACTION

A. Five-Year OCS Program Approval and Litigation

Section 18 of the Outer Continental Shelf Lands Act (OCSLA), as amended, 43 U.S.C. 1344, requires the Secretary of the Interior to prepare, annually review, periodically revise, and maintain a 5-Year Oil and Gas Leasing Program for the U.S. Outer Continental Shelf (OCS). One of the principal purposes of the OCSLA, as amended is to establish policies and procedures which will result in expedited exploration and development of OCS oil and gas resources to achieve national economic and energy policy goals. Consistent with these requirements, the Department of the Interior (DOI) prepared a 5-year program for the period of mid-1987 through mid-1992. The Proposed Final Program contained a schedule of proposed lease sales "indicating as precisely as possible, the size, timing, and location of leasing activity."

Section 18 mandates that the 5-year program identify the size, timing, and location of leasing and provide for the receipt of fair market value for lands leased and rights conveyed. Section 18 also details both the factors to be considered in the formulation of a new leasing program and the public consultation process, which is designed to provide further information for consideration. Prior to the 1987 program, section 18 requirements have been interpreted by the October 6, 1981, and July 5, 1983, decisions of the U.S. Court of Appeals for the District of Columbia Circuit. The July 5, 1983, decision upheld the 1982 leasing program which preceded the current program.

On July 2, 1987, the Secretary approved the Final 5-Year OCS Oil and Gas Leasing Program. Following this approval, petitioners filed suit in the U.S. Court of Appeals for the District of Columbia Circuit. Petitioners included the Natural Resources Defense Council (NRDC); the States of California, Florida, Massachusetts, Oregon, and Washington; and various environmental groups. They challenged the Secretary of the Interior's OCS Program on a variety of grounds, including alleged violations of the National Environmental Policy Act (NEPA), section 18 of the OCSLA, and section III of Public Law 99-591 (which imposed special procedures for considering leasing offshore California). The petitioners' cases were consolidated on January 29, 1988. The American Petroleum Institute among others, intervened as respondents.

The court found for DOI on all but one of the grounds on which the program was challenged. The court held that in the Final Environmental Impact Statement for the Proposed 5-Year Program (FEIS) the Secretary failed to perform an adequate analysis of the leasing program's potential cumulative impacts on migratory species. The court remanded that matter to the Secretary for further attention and for any revision to the 5-year program that the Secretary might deem necessary as a result of this new analysis.

To respond to the court's remand, and to achieve the objectives outlined by the court, the Supplemental EIS (SEIS) analyzes only the cumulative impacts of OCS development on migratory species whose migration routes traverse more than one planning area in the Alaska and Pacific Regions. The analysis is based on the court's premise that the Secretary did not consider the effects of simultaneous inter-regional development on migratory species. In taking into consideration this issue raised by the court, resource estimates from the cumulative case scenario in the FEIS were aggregated (see Section II.B.1). The cumulative impact analysis is also presented in a single, coherent section rather than fragmented by planning area. It also describes and incorporates into the analysis the OCS and non-OCS activities along those migration routes. Section 18 of the OCSLA requires that any significant revision of an approved program be submitted to the procedural requirements of developing a new program.

B. Scoping

Information from Federal, State, and local agencies, and the public regarding alternatives and issues which should be evaluated in the EIS for the Proposed 5-Year Program were solicited during the initial scoping period. Respondents focused their comments on the significant environmental issues attendant to OCS oil and gas leasing and development, and on alternative leasing schedules and presale processes which should be evaluated in the EIS. Issues related to scoping are presented in Section I.E. (pages I.-21 to I.-30) in the FEIS.

The concerns initially raised are still relevant to the cumulative analysis and, therefore, were considered during the analysis process in this SEIS. However, the initial scoping process was updated to select specific species for analysis. In determining the migratory species to be analyzed in the SEIS pursuant to the court's opinion, the analysts initially focused on the general groups of species within the coastal and offshore areas of the Alaska and Pacific Regions. The migratory species within these groups (marine mammals, coastal and marine birds, fishes and sea turtles) were then identified. Whether a species had a large areal distribution or was a random visitor to an area was taken into consideration when determining the species list.

An additional criterion for evaluation was whether a species migrated through more than one OCS planning area. Based on this criterion several species included in the analysis are not true migrants but rather are dispersers.

After determining the species lists to be analyzed, the list was reviewed again and in some instances species were classified into groups based on whether they had similar migration routes, behavior, and responses to impact producing agents and/or activities as a result of offshore oil and gas activities, and non offshore oil and gas activities. A candidate or key species from these groups were selected for analysis.

In accordance with CEQ regulations (40 CFR 1501.7), the following species were eliminated from further analysis:

MARINE TURTLES: Three endangered and one threatened sea turtles could occur offshore the Pacific Region (the green sea turtle (*Chelonia mydas)*, leatherback turtle (*Dermochelys coriacea*), Pacific ridley turtle (*Lepidochelys olivacea*), and loggerhead sea turtle (*Caretta caretta*), respectively). Sea turtles are, at best, infrequent visitors to coastal California, as they typically inhabit tropical and subtropical seas (Smith and Houch 1989; Stebbins 1966). The only area in the Pacific Region where turtles are sighted with any frequency is the coastal waters of San Diego County.

During 3 years of surveying offshore California the majority of observations were leatherback turtles (29 sightings of 31 turtles) (Dohl et al., 1983). As it is uncommon to observe sea turtles north of the Southern California Planning Area, these animals were excluded from this analysis.

ALEUTIAN CANADA GOOSE: The Aleutian Canada goose is an endangered migratory species that nests in the Aleutian Islands of Alaska and winters in California and Oregon. The species nests in terrestrial habitats and is not known to frequent ocean areas. The population is believed to undergo a non-stop transoceanic migration from nesting to wintering areas. Consequently, it does not appear that the species will be affected by the 5-year program, and therefore this species is not analyzed in the SEIS.

ALBACORE TUNA: Juvenile and adult albacore tuna may occur seasonally offshore California, Oregon, and Washington as part of their transoceanic migration from the central and western north Pacific. Spawning of albacore occurs in the oceanic waters of the central and western Pacific between Hawaii and Japan, with the juveniles and adults typically completing one circuit of their migration per year. Albacore typically pass through the Pacific Region in the late spring, summer, and early fall, but the timing, location, and extent of their northward movement from Mexico and southern California is highly variable and largely a function of temperature and other oceanographic conditions. During their migration through the Pacific Region, albacore occur primarily at distances of 80-500 km offshore, and at depths of 30-180 meters. Since the vast majority of juvenile and adult albacore occur far offshore and in relatively deep water, and the potentially most sensitive early life history stages (i.e., eggs and larvae) occur in the western Pacific, OCS and non-OCS oil and gas activities are not expected to impact the north Pacific albacore population.

OTHER FISH SPECIES: Several species of fish occurring in the Pacific Region exhibit some degree of coastal movement. These species include thresher shark, northern anchovy, bonito, and mackerel (jack and Pacific). In general, the coastal movements of these species are restricted to one or two planning areas within the Pacific Region, and they are not truly migratory as is the case with salmon, steelhead, and whiting. The coastal movements of these species are most likely related to reproductive activity, and seasonal changes in water temperature or other oceanographic conditions. Impacts to regional populations or subpopulations of these species as a result of OCS oil and gas activities are not expected since pelagic species such as these are distributed and spawn over a large geographic area and depth range.

CHAPTER II

ALTERNATIVES

II. ALTERNATIVES

A. Introduction

Since its approval on July 2, 1987, some modifications to the program's schedule have been made as a result of rescheduling of sales for a later date, sales "on hold", and sales being deferred. The purpose of this EIS is to supplement the cumulative impact analysis in the FEIS, and to reassess whether changes to the current 5-year program are warranted. Therefore, this section describes the program as adopted by the Secretary, and provides a summary of the cumulative impacts of the current program on migratory species.

The court also suggested that the Secretary could examine alternatives to simultaneous development that would mitigate any cumulative impacts on migratory species. Alternatives were designed explicitly to mitigate, if necessary, the potential impacts to migratory species caused by the 5-year program. The analysis in Section IV.D. of this document distinguishes impacts to migratory species from existing OCS and non-OCS activities from the impacts associated with the current and future 5-year programs. Because of this distinction, the analysis presented in Section IV.D. also serves as the analytical basis for Alternatives II and III. This section provides a summary of these alternatives.

B. Description of the Alternatives

1. Alternative I - 1987 Program

The following is a brief description of the 5-year program, as approved. A description of the 1987 Program may be found in the Proposed Final 5-Year Program Document (DOI, Minerals Management Service (MMS), 1987). The key features of the new 5-year program include:

a. Schedule of Sales

A total of 38 sales are scheduled in 21 of the 26 planning areas. These sales include: 24 standard lease sales including annual sales in the Central and Western Gulf of Mexico and 14 triennial sales in 9 other planning areas. Of the 38 sales, 11 are frontier exploration sales scheduled at a triennial or less frequent pace. Also included are 3 small supplemental sales outside the Central and Western Gulf of Mexico for selected blocks (including those on which bids were rejected or forfeited during the fiscal year prior to the sale) and for development blocks (including blocks susceptible to drainage).

b. Subarea Deferrals

The 1987 Program defers subareas within 13 planning areas and highlights other subareas within 7 planning areas for special consideration during the presale process.

c. Status of the Current Program

Since the current 5-Year Program was approved on July 2, 1987, several events have resulted in modifications to the schedule. Seven sales were held including two sales in the Alaska Region - Sale 97, Beaufort Sea, and Sale 109, Chukchi Sea.

A Presidential Task Force has been formed to study leasing in three controversial areas. The areas being studied by the task force are the Sale 91 area off northern California, the Sale 95 areas off southern California, and the Sale 116 (part II) the area south of 26 degrees north latitude in the eastern Gulf of Mexico. The efforts of this Presidential Task Force should be concluded and the recommendations sent to the President by January 1990.

d. Resource Estimates

The analysis in the SEIS is based on the court's premise that the Secretary did not consider the effects of simultaneous inter-regional development on migratory species. In taking into consideration this issue raised by the court, the cumulative case scenario previously analyzed was reviewed to determine if the assumptions made in the FEIS were still valid. This review took into consideration the program as adopted by the Secretary on July 2, 1987, as well as the program's status. It was determined that the FEIS cumulative case scenario was still valid; however, to address simultaneous inter-regional development the resources associated with the FEIS cumulative case scenario were aggregated.

The resource estimates for the FEIS cumulative case scenario for the proposed program include the total leased and unleased resources, and the total developed and undeveloped reserves in the planning areas. The FEIS cumulative case also assumed that (1) all resources will eventually be developed although no assumption was made regarding the pace of leasing and development in future 5-year leasing programs; and (2) the total resource potential (leased and unleased) contributed to the scenario's infrastructure.

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The FEIS cumulative case scenario for the proposed program was not dependent on a specific pace for leasing and development. Changes in the scheduling of sales for a later date, those "on hold," or deferred would not modify the resource estimates, infrastructure or assumptions previously made. Upon inspection, the same assumptions (see Section II.B.1.e) are still valid, since it was assumed that resource estimates associated with these sales would be developed over the next 35 to 40 years. As part of the original assumption, the total resource potential of the planning area contributed to the cumulative scenario's infrastructure. In each case, the infrastructure estimates represent the possible level of oil and gas activity needed to develop the resources in the planning areas. To analyze simultaneous development as requested by the court, it was assumed that this activity would occur concurrently. Therefore, no significant difference exists in the cumulative case scenario assumptions between the proposal previously analyzed and the alternative as adopted by the Secretary, as well as the current status of the 5-Year OCS Program.

The potential oil and gas resources within each planning area were assessed (Table II.B.1-1) for the FEIS, using all relevant available geologic and geophysical data and the PRESTO (Probabilistic Resource Estimates - Offshore) Model. Estimates of the conditional, undiscovered, economically recoverable resources and their associated marginal probabilities were derived for each planning area. The major elements constituting PRESTO and the method used to develop the probabilistic oil and gas resource estimates for the planning areas are described in OCS report MMS 85-0012.

The resource estimates used in the cumulative case scenario in the SEIS are conditional resource estimates for each of the planning areas in the Alaska and Pacific Regions. The conditional resource estimates include estimates of total leased and unleased resources, and total developed and undeveloped reserves in the planning areas. Conditional resource estimates are quantities of oil and gas resources that may be found and developed given the condition that economically recoverable accumulations of hydrocarbons are present in the area. The marginal probability of hydrocarbons (MP_{HC}) represents the likelihood that economically recoverable volumes of hydrocarbon resources exist in the planning areas.

If a direct comparison of the resource estimates and associated infrastructure is to be made, it is necessary to apply the marginal probabilities (1 minus risk factor) to the individual planning area estimates prior to aggregating either the resource estimates or the associated infrastructure.

Assuming geologic independence between planning areas, the marginal probability that the conditional mean levels of resources will be discovered and developed for all the planning areas simultaneously is the product of the marginal probabilities of occurrence that the conditional mean level of resources for each planning area will be discovered and developed independently. Based on this calculation, it is highly unlikely that these events would occur for all planning areas simultaneously (Actual calculation = $1.47010797 \times 10^{-12}$).

However, in order to comply with the court's remand concerning simultaneous interregional development, additional assumptions had to be made. For analysis purposes only, the conditional resource estimates and the associated infrastructure presented in Table II.B.1-1 reflect the level of activity that was estimated to occur in each planning area as a result of the simultaneous occurrence of: (1) the development of existing reserves; (2) the development of the conditional mean level of leased resources; and (3) the leasing, discovery, and development of the conditional mean level of all remaining unleased resources.

Since the publication of the FEIS, a joint MMS and U.S. Geological Survey assessment of the undiscovered oil and natural gas resources for the Nation was carried out. This National Resource Assessment (NRA) resulted in updated resource estimates for offshore United States. An evaluation of the updated resource estimates was made to assess whether it was appropriate to use the new resource estimates for the impact analysis.

The NRA conditional resource estimates in barrels of oil equivalent (BOE) for the corresponding planning areas in the Alaska and Pacific Regions, previously analyzed in the FEIS, are presented in Table II.B.1-2. As stated above, the conditional estimates are not additive among planning areas. The reader should also note that the conditional estimates are not comparable between planning areas or between assessments, since they are based on different marginal probabilities. Conditional estimates must be risked (multiplied by MP_{HC}) before being added or compared.

The decrease in the resource estimates in the new national assessment for eight of the Alaska planning areas is generally attributed to geologic information gained from unsuccessful exploratory drilling since

Table II.B.1-1 Conditional Oil and Gas Resources, Reserves, and Infrastructure for the FEIS and SEIS Cumulative Case

PLANNING AREA	OIL (MMBBL)	GAS (BCF)	Million BOE	MPHC*	NO. OF EXPL.& DEL. WELLS	NO. OF DEV.& PROD. WELLS	PLATFORMS
Beaufort Sea	1280	--	1280	0.70	38	126	3
Chukchi Sea	2680	--	2680	0.20	85	263	7
Hope	170	1810	492	0.02	13	49	1
Norton	640	2940	1163	0.15	45	112	4
Navarin	4800	5840	5839	0.27	179	569	14
St. George	1690	15760	4494	0.22	147	444	12
N. Aleutian	360	2620	826	0.20	26	80	2
Shumagin	50	1420	303	0.03	11	30	1
Kodiak	150	2920	670	0.05	24	66	2
Cook Inlet	210	350	272	0.03	11	25	1
Gulf of Alaska	540	8340	2024	0.08	63	200	5
Washington/Oregon	180	3260	760	0.20	33	90	3
N. California	420	1860	751	0.60	33	88	3
C. California	300	560	400	0.65	21	46	2
S. California**	2613	4087	3340	1.00	524	2145	48

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* MP_{HC} denotes marginal probability of commercial hydrocarbons.

** Includes developed and undeveloped reserves. The infrastructure for the Southern California Planning Area includes existing, proposed and hypothetical platforms and development and production wells.

Estimates of levels of exploration and development expressed in this table are based solely on the conditional resource level of the planning areas and are therefore, themselves conditional estimates.

MMBBL - Millions of Barrels
BCF - Billion Cubic Feet
BOE - Barrels of Oil Equivalent

Table II.B.1-2 Conditional Oil and Gas Resources, Reserves, and Infrastructure for the 1987, National Resource Assessment

			NO. OF		
PLANNING AREA	Million BOE	MPHC*	EXPL. & DEL. WELLS	DEV. & PROD. WELLS	PLATFORMS
Beaufort Sea	1440	0.14	43	142	3
Chukchi Sea	2730	0.22	87	268	7
Hope	660	0.01	17	66	1
Norton	580	<0.01	22	56	2
Navarin	1140	0.03	35	111	3
St. George	390	0.02	13	39	1
N. Aleutian	610	0.02	19	59	1
Shumagin	280	0.01	10	28	1
Kodiak	430	0.03	15	42	1
Cook Inlet	170	<0.01	6	16	1
Gulf of Alaska	980	0.04	30	97	2
Washington/Oregon	540	0.25	23	64	2
N. California	870	0.60	38	102	3
C. California	371	0.90	19	43	2
S. California**	3239	1.00	489	2066	46

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* MP_{HC} denotes marginal probability of commercial hydrocarbons.

** Includes developed and undeveloped reserves. The infrastructure for the Southern California Planning Area includes existing, proposed and hypothetical platforms and development and production wells.

Estimates of levels of exploration and development expressed in this table are based solely on the conditional resource level of the planning areas and are therefore, themselves conditional estimates.

BOE - Barrels of Oil Equivalent

the publication of the FEIS. To some extent the decreases are the effect of less favorable economic variables in these estimates. The minor increases in some of the estimates are attributed to new mapping using recently obtained geologic information. However, these increases do not appreciably change the hypothetical infrastructure associated with these estimates.

The changes in the resource estimates were evaluated in terms of how they would effect the cumulative impact assessment and the assumptions previously used. Basic assumptions in the FEIS were considered still valid since there were no significant increases in infrastructure based on the new national assessment numbers. The decreases in conditional mean resource estimates, based on professional judgment, would result in lowering potential impacts associated with the development of these resources. The conditional resource estimates for the cumulative case scenario from the FEIS were used for the analysis in this document because those estimates provide consistency between the FEIS and the SEIS. This approach also complies with the court's remand for the Secretary to review the leasing program, as adopted, and to supplement the previous cumulative analysis.

e. Exploration and Development Assumptions

Table II.B.1-1 also identifies the level of offshore activity which may result from the exploration, the delineation of possible hydrocarbon bearing formations, and the establishment of production platforms. The estimates of infrastructure associated with these conditional resources were developed for evaluating the potential levels of impacts. As stated above, the likelihood of the listed development levels actually taking place in a planning area is based on the marginal probability of that area. However, based on necessary calculations it is highly unlikely that these events would occur for all planning areas simultaneously (Actual calculation = $1.47010797 \times 10^{-12}$).

The following basic assumptions are consistent with those made in the FEIS Sections IV.A.1 and IV.A.2 (pages IV.A.-3 to IV.A.-19).

> The resource estimates for the cumulative case include estimates of total leased and unleased resources, and the total developed and undeveloped reserves in the planning areas.
>
> It is assumed that all resources will eventually be developed; however, no assumption is made regarding the pace of leasing and development in future 5-year leasing programs.
>
> The total leased and unleased resource potential and the total developed and undeveloped reserve estimates as of July 1984 will contribute to the scenario's infrastructure. Therefore, the infrastructure for the Southern California Planning Area includes existing, proposed, and hypothetical platforms and development and production wells.
>
> Exploration, development, and production from the Pacific Planning Areas are estimated to last a total of 35 years.
>
> Exploration, development, and production from the Alaska Planning Areas are estimated to last a total of 40 years. This period includes additional time required to bring platforms into production.
>
> Southern California conditional oil and gas resources include developed and undeveloped reserves.
>
> It is assumed that the conditional oil and gas resources within the Kodiak Planning Areas will be leased and developed as a result of future 5-year leasing programs. However, no assumption is made regarding the pace of leasing or development.

In response to the court's remand, an additional assumption for the purposes of this analysis only, assumes that some level of exploration and development in the Pacific and Alaska Regions during the next 35 to 40 years will occur simultaneously.

f. Projected Transportation and Markets

The projected transportation and markets assumptions for the SEIS tier from the discussion in Section IV.A.3 (pages IV.A.-19 to IV.A.-25) of the FEIS. Sections IV.B.4.a, IV.B.4.b, and IV.B.c of the SEIS summarize these basic assumptions concerning how oil and gas production will be transported to shore and whether production will be transported by tankers or by pipelines to markets inside or outside of the planning areas. Table IV.B.4-1 presents the specific transportation mode scenarios used in the cumulative analysis. For consistency with the FEIS, the same transportation modes and assumptions were made. The allocation of the percentage of transportation by pipelines versus by tankers in a planning area is based on the assumptions presented in this section and existing transportation networks.

g. Summary of Cumulative Impacts

Table II.B.1-3 indicates the cumulative impact levels for the 1987 Program on migratory species in the Alaska and Pacific OCS Regions. The cumulative impact level takes into account the effects expected from non-OCS oil and gas activities, existing oil and gas activities, as well as those from the 1987 Program. The detailed impact analyses are included in Section IV.D.

Five levels of impact are defined for each resource category. These impact levels are used in the conclusion for each resource being analyzed in Section IV.D. Impact levels indicate the degree of intensity or severity of the impact inferred from the analysis. The five levels of impact are designated by the following qualitative terms indicating the degree of impact: very low; low; moderate; high; and very high. The term "negligible" is sometimes also used. Definitions of the impact levels for each resource category may be found in Appendix A.

2. Alternative II - Defer Leasing in One or More Planning Areas

This alternative would defer leasing in one or more planning areas in the Alaska and Pacific Regions. The purpose for deferral is to avoid the simultaneous oil and gas development activities that were identified in Section IV.D. as causing impacts on one or more migratory species. It is assumed for this analysis that any planning area deferred under this alternative would also be deferred from leasing under future 5-year programs. Adopting this alternative eliminates the possibility that simultaneous development could occur in the Pacific and Alaska Regions as a result of the 5-year program. A planning area deferral alternative also addresses the court's request that the Secretary consider alternatives to simultaneous development.

The analysis for this alternative considers the potential for deferral to reduce the level of cumulative impact on one or more migratory species. This reduction would be possible only in instances where the level of cumulative impact with the 5-year program is higher than the level of impact without the program. The analysis present in Section IV.D. provides the basis for identifying migratory species that are expected to be substantively affected by the 5-year program. The analysis further considers whether deferral of one or more planning areas from future leasing would reduce the cumulative impact by one level or more.

With the assumption of simultaneous development along the migratory routes of the various species (marine mammals, fish resources, coastal and marine birds), the overall cumulative impacts range from very low to high. In many instances these migratory species are experiencing various levels of impacts from existing activities (see Section IV.D.). However, when the overall expected level of impacts from all sources is compared with the level of impacts from existing impact producing factors or agents (see Section IV.D.), these levels did not appreciably change with the exception of the northern fur seal.

Existing impact producing factors or agents (OCS and non-OCS) are currently causing a moderate level of impact to the northern fur seal while the overall level of cumulative impacts with the addition of this 5-year program and future 5-year programs is high. The deferral of the development and transportation of oil resources within the St. George Planning Area during this and future 5-year programs would reduce the risk of contact to this localized northern fur seal population during periods of concentration. Therefore, this alternative would reduce the impacts to the northern fur seal from high to moderate. Impacts to other migratory species would remain at the same level as for Alternative I.

The deferral of the St. George Planning Area from future leasing would also result in the elimination of all potential impacts from the current and future leasing programs on all components of the physical, biological, and socioeconomic environment within the planning area. Impacts to these resources which would be avoided by the deferral of this planning area are analyzed in Section IV.B.16. (pages IV.B.16-1 to IV.B.16-3) of the FEIS.

3. Alternative III - No Action

The evaluation of a "no action" alternative is required, however, by the regulations implementing NEPA (40 CFR 1502.14(d)). For the purpose of this analysis only, this alternative assumes that the remaining lease sales within the Alaska and Pacific Region will be deferred for the remainder of the period covered by the 5-year program approved by the Secretary on July 2, 1987. This alternative would constitute the most extreme level of mitigation to eliminate simultaneous development.

Table II.B.1-3
Alternative I
Overall Cumulative Impact Levels on Migratory Species

Resource Category	Cumulative Impact Level
Marine Mammals	
Threatened or Endangered Cetaceans	
Bowhead Whales	Low
Gray Whale	Low
Fin and Humpback Whales	Very Low
Right, Blue, Sei, and Sperm Whales	Very Low
Nonendangered Cetaceans	
Beluga Whale	Low
Minke Whale	Very Low
Harbor Porpoises	Moderate
Pinnipeds	
Northern Fur Seal	High
Steller Sea Lion	Moderate
Guadalupe Fur Seal	Very Low
California Sea Lion	Very Low
Northern Elephant Seal	Very Low
Harbor Seal	Low
Polar Bear	Low
Marine and Coastal Birds	
Endangered and Threatened Birds	
Arctic and American Peregrine Falcon	Low
Short Tailed Albatross	Low
California Least Tern	High
California Brown Pelican	Moderate
Nonendangered Birds	
Geese	
White-Fronted Goose	Moderate
Emperor Goose	Moderate
Cackling Canada Goose	Moderate
Pacific Black Brant	Moderate
Other Geese	Moderate
Diving Ducks	Moderate
Waterfowl	Low
Seabirds	Moderate
Shorebirds	Low
Fisheries Resources	
Pacfic Salmon	
Alaska Region	Very Low
Pacific Region	Moderate
Walleye Pollack	Very Low
Steelhead Trout	Moderate
Pacific Whiting	Moderate

Under this alternative the only Federal oil and gas activities in the Pacific and Alaska Regions would be from previously leased areas. A comparison of the effects from existing activities and the current and future 5-year programs indicates that the 5-year programs does not increase impacts to migratory species above impact levels from existing activities, with the exception of northern fur seals.

Existing impact producing factors or agents (OCS and non-OCS) are currently causing a moderate level of impact to the northern fur seal while the overall level of cumulative impacts with the addition of this 5-year program and future 5-year programs is high. The deferral of the development and transportation of oil resources within the St. George Planning Area during this and future 5-year programs would reduce the risk of contact to this localized northern fur seal population during periods of concentration.

The deferral of the St. George Planning Area from future leasing would also result in the elimination of all potential impacts from the current and future leasing programs on all components of the physical, biological, and socioeconomic environment within the planning area. Impacts to these resources which would be avoided by the deferral of this planning area are analyzed in Section IV.B.16. (pages IV.B.16-1 to IV.B.16-3) of the FEIS.

The deferral of leasing in these planning areas would also result in the elimination of all potential impacts as a result of the exploration, development, and production activities on all components of the physical, biological, and socioeconomic environment within the planning area. Impacts to these resources which would be avoided by the deferral of these planning area are analyzed in Section IV.B. of the FEIS.

CHAPTER III

DESCRIPTION OF MIGRATORY SPECIES

III. DESCRIPTION OF MIGRATORY SPECIES

A. Introduction

This chapter discusses the current population status and general migratory routes of selected migratory species in the Alaska and Pacific coastal and offshore regions. The Pacific Region extends from the United States-Mexico Border to the United States-Canada border. The area is subdivided into four administrative planning areas (see Figure III.A-1). A detailed description of the affected environment of the coastal and offshore regions of the planning areas in the Pacific Region is contained in Section III.C. (pages III.C.-1 to III.C.-124) of the FEIS for the Proposed 5-Year Program.

The Alaska Region is divided into 3 subregions: the Arctic, the Bering Sea, and the Gulf of Alaska. The subregions have been further divided into 15 administrative planning areas (see Figure III.A-2). A detailed description of the affected environment of the coastal and offshore regions of the planning areas in the Alaska Region is contained Section III.D. (pages III.D.-1 to III.D.-100) in the FEIS for the Proposed 5-Year Program.

B. Marine Mammals

1. Threatened or Endangered Cetaceans

a. Bowhead Whale

Individuals of the estimated 7,800 western arctic stock of bowhead whales (Zeh, Reilly, and Sonntag, 1988) migrate through a number of Alaska OCS Region planning areas. Summer-feeding grounds are located in the Canadian Beaufort Sea, and wintering areas are present in the Bering Sea.

In recent years, population estimates have risen dramatically, although the reason behind this increase is more likely due to better censusing techniques than to a rapidly increasing population. The current population estimate may be about 40 percent of the historic population level prior to commercial exploitation (based upon numbers cited by Braham (1984b)). The species presently appears to be much more abundant than at the close of the commercial whaling period, just after the turn of the century, when it was estimated that there were probably not less than 1,000 animals. Commercial whaling during the latter half of the 19th century had decimated the bowhead whale population, and the cessation of commercial bowhead whaling due to the collapse of the market for whale oil and baleen allowed the population to slowly recover. The species is now protected from commercial whaling, although there has continued to be a subsistence hunt by Alaska Natives. This subsistence hunt probably slows the population growth somewhat, but does not appear to result in a population decline.

After summer feeding in the Canadian Beaufort Sea, bowheads begin moving westward in August into Alaskan waters. Bowheads continue to feed intermittently as they migrate across the Alaskan Beaufort Sea, primarily during September and October. Conditions can vary during the fall migration from open water to over 90 percent ice coverage. Most bowheads migrate through water depths ranging from 10 to 50 meters (Ljungblad, Moore, and Van Schoik, 1984a).

Data on the bowhead fall migration through the Chukchi Sea is limited; however, it appears that before they move south into the Bering Sea, most bowheads cross the Chukchi Sea in a broad front from Point Barrow to the northern coast of the Chukotsk Peninsula (Ljungblad, Moore, and Van Schoik, 1984b). Most whales enter the Bering Sea by the first part of November, in advance of winter pack ice.

Though not well-defined, the bowheads' winter range appears to be in the central and western Bering Sea, from south and west of St. Lawrence Island to the ice front (Brueggeman, 1982; Brueggeman, Grotefendt, and Erickson, 1984). The bowheads' northward spring migration appears to be timed with the ice breakup, usually beginning in April (Braham, Krogman, and Carroll, 1984). In the Chukchi Sea, they follow leads in the flaw zone from outer Kotzebue Sound to Barrow. After passing Barrow from April through mid-June, they move through offshore leads in an easterly direction. East of Point Barrow, the lead systems divide into numerous branches that vary in location and extent yearly. Bowheads arrive at their summer feeding grounds in the vicinity of Banks Island/Amundsen Gulf about late May to June (Fraker, 1979).

Bowheads apparently feed throughout the water column (Wursig et al., 1984), and they have been observed feeding during their spring and fall migration. Food items most commonly found in the stomachs of harvested bowheads include euphausiids, mysids, copepods, and amphipods (Lowry and Frost, 1984). Areas to the east of Barter Island appear to be used regularly for feeding as bowheads

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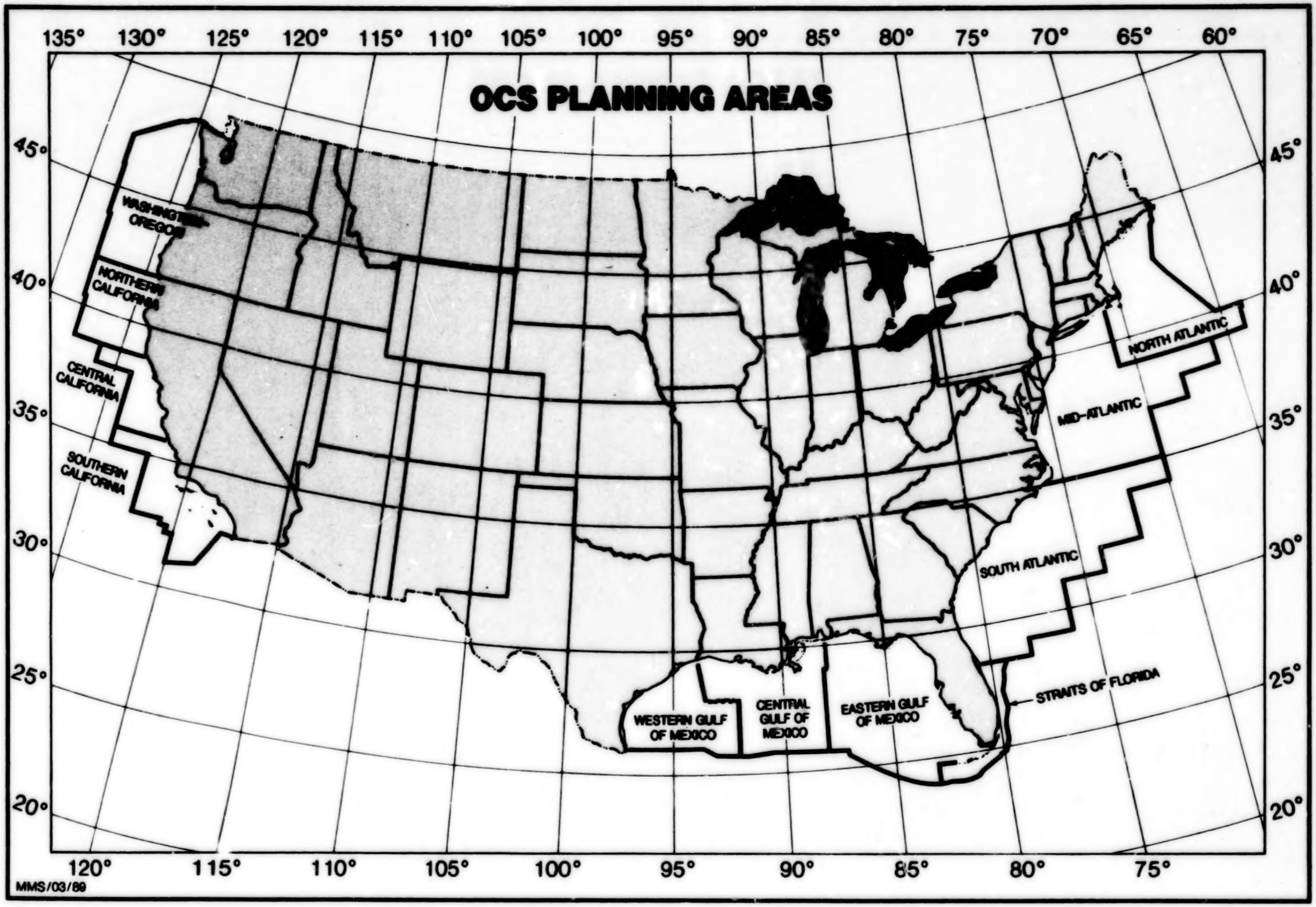

Figure III.A-1 Outer Continental Shelf Planning Areas

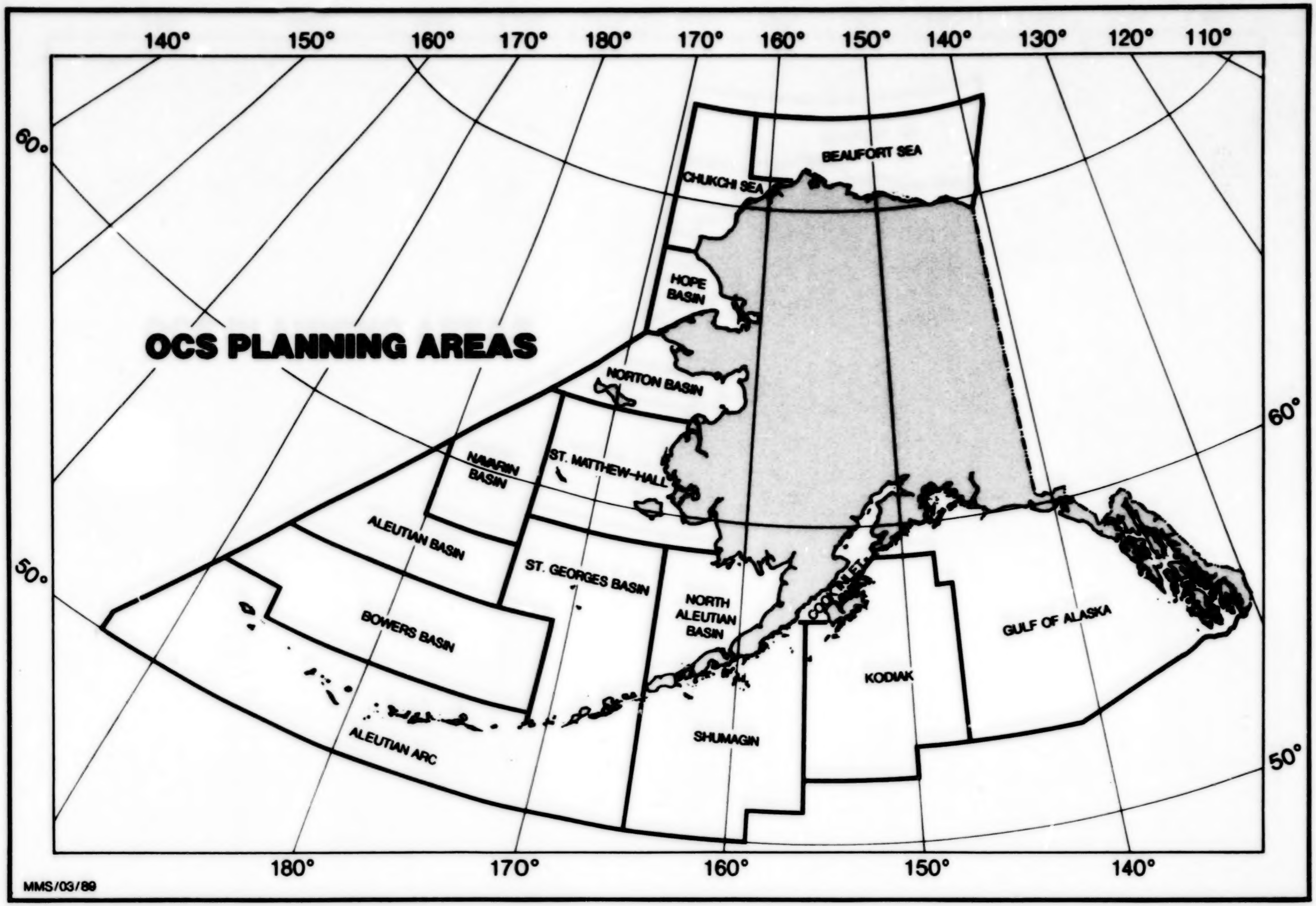

Figure III.A-2 Alaska Region Planning Areas

migrate slowly westward across the Beaufort Sea (Thomson and Richardson, 1987), and in some years sizeable groups of bowheads have been seen feeding east of Point Barrow near the Plover Islands (Braham, Krogman, and Carroll, 1984; Ljungblad, et al., 1985). Carbon isotope analysis of bowhead baleen has indicated that a significant amount of feeding may occur in wintering areas (Schell, Saupe, and Haubenstock, 1987). Bowheads were also observed feeding in the spring in the vicinity of Point Barrow during 1985 and 1986, indicating that bowheads will opportunistically feed in this area when food is available (Carroll and George, 1985; George et al., 1987).

Bowhead mating and calving appear to occur during the spring migration. Late winter is the most probable mating season, when most of the population is located in the Bering Sea (Nerini et al., 1983). However, mating behavior has also been reported north of Point Barrow (Everitt and Krogman, 1979). The peak of calving probably occurs in May, although the calving season could extend in some years from late March until early August (Nerini et al., 1983).

b. Gray Whale

The eastern Pacific gray whale stock is estimated at approximately 21,000 individuals (Breiwick et al., in press). Due to commercial whaling, this stock was severely depleted by the early 1900's, however, under legal protection, the eastern Pacific gray whale stock has recovered to previous numbers (Rice, Wolman, and Braham, 1984). In recent years, the population has grown by an estimated 2.5 percent per year (Reilly, Rice, and Wolman, 1983).

Major gray whale summer feeding areas exist in the northern Bering and southern Chukchi Seas. Smaller numbers of whales summer in the Beaufort and eastern Siberian Seas, in nearshore waters and estuaries along the northern coast of the Alaska Peninsula, and in the waters off British Columbia, Oregon, and northern and central California. While at their feeding grounds, grays are often sighted singly; however, several hundred may be distributed within a few dozen square kilometers in the rich food areas of the northern feeding grounds (Leatherwood, Reeves, and Foster, 1983).

The southbound migration from summer feeding areas generally begins in mid-October (Johnson et al., 1981), although Moore and Ljungblad (1984) recorded gray whales in the northern waters of the Bering Sea until at least November. Gray whales depart the Bering Sea through Unimak Pass, mainly in November and December. The whales migrate near shore along the coast of North America from Alaska to central California. Off northern and central California, the major pulse of southbound migration occurs in late December through January. Gray whales travel considerably closer to shore than other species. Most of the southbound animals are sighted within 3.7 km of the mainland. After passing Point Conception, California, the majority take a more direct offshore route across the southern California Bight to northern Baja California. Nerini (1984) indicates that some feeding probably occurs in winter and during the fall migration, as well as during the spring migration, through Alaskan waters (Braham, 1984a).

A large portion of the gray whale population uses the west coast Baja lagoons or nearby waters during the winter (8,000 in 1981); gray whale densities in these areas far exeed those in any other part of their range. From January to March, gray whales are present in major calving and breeding areas along the outer coast of Baja California including Ojo de Liebre (Scammon's) Lagoon, Guerrero Negro Lagoon, San Ignacio Lagoon, and Magdalena Bay and its adjacent protected waters (Rice and Wolman, 1971). Calves are born from early January to mid-February.

The majority of gray whales begin their northbound migrations around March, although some whales apparently start earlier (Braham, 1984a), beginning as early as mid-January and continuing through late June. In California, the migration occurs in two phases--first, those animals "unencumbered with newborns," then mothers with young calves. In northern and central California, the northbound gray whale migration occurs from February to June.

After traveling north along the coasts of Oregon, Washington, British Columbia, and the Gulf of Alaska, gray whales enter the southeastern Bering Sea through Unimak Pass in spring and early summer (March through June). Migrating whales follow the west coast of Unimak Island and continue their coastal migration through the North Aleutian Shelf area (within 1-2 km of shore) until they near Egegik Bay. There they begin to head across northern Bristol Bay, maintaining a distance of 5 to 8 km from shore (DOI, MMS, 1985). Some feeding occurs along the west coast of Canada, in the Gulf of Alaska, and in the Bristol Bay area (Gill and Hall, 1983; Braham, 1984). Once gray whales reach Nunivak Island, they

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head offshore to their primary feeding grounds off St. Lawrence Island, in the Chirikov Basin, and in the southern Chukchi Sea.

During summer, gray whales--like the other great whales--build up fat on which they apparently survive during the fall, winter, and spring. Gray whales are primarily bottom feeders, selecting high biomass areas in their northern feeding grounds. The stomach contents of whales taken by Soviet whalers in one area of the Chirikov Basin consisted of 95 percent sedimentary ampeliscid amphipods, usually 13 to 27 millimeters (mm) long (Nerini, 1984). In addition to benthic suction feeding, the gray whale is also capable of feeding on pelagic prey by skimming and engulfing, as reported by several authors in Nerini (1984). This mode of feeding may be used in areas where mobile scavenging arthropods are present, or in Baja California where stomach contents have contained bait fish (Nerini, 1984).

c. Fin and Humpbacks Whales

(1) Fin Whale

Fin whales range from subtropical to arctic waters. It is estimated that, prior to the advent of modern whaling, the North Pacific population ranged from 42,000 to 45,000 individuals. By the time commercial whaling had ended, the population had been reduced to an estimated 14,620 to 18,630 individuals (Ohsumi and Wada, 1974). North Pacific fin whales have been protected from commercial whaling since 1976; as a result, the population should be increasing. However, recent sighting data have been slight and difficult to interpret, and it appears that the population remains at less than half its pre-exploitation level (Mizroch, Rice, and Breiwick, 1984b).

The summer distribution of fin whales extends from central California into the Chukchi Sea. In Alaskan waters, some whales spend the summer feeding in the Gulf of Alaska, while others migrate further north. Fin whales present in the Bering Sea divide into two groups; one follows the shelf-break zone to Cape Navarin (mainly mature males and females without calves), and a second group (mostly lactating females and juveniles) remains in the region north of Unimak Pass (Morris, 1981). Fin whales feed throughout the Bering and Chukchi Seas from late June through October. Other summer feeding concentration areas are located along upwelling fronts and include the areas southwest of St. Matthew Island and south of the Aleutian Islands (Nasu, 1966). From May to August, concentrations of fin whales also occur from 144° to 150o W. longitude and from 56° to 59° N. latitude including parts of Portlock Bank, and in an area from the Shumagin Islands to the Trinity Islands. Fin whales occur primarily in high-relief areas where biological productivity is probably high (Brueggeman et al., 1988).

Fin whales winter in subtropical to temperate waters. The southward migration begins in September and continues through November. By November, most fin whales have arrived at their winter grounds off southern California. The winter distribution (November to January) in the eastern North Pacific extends from central California to Baja California (approximately 20° N latitude), where much of the population is believed to winter far offshore (Leatherwood et al., 1982). Brueggeman, Grotefendt, and Erickson (1984) found that a few fin whales remained during the winter in Alaska's Navarin Basin.

The northward migration begins in spring. The fin whale was once the most abundant large baleen whale off California in spring and summer, with a peak abundance in May or June. Migrating whales enter the Gulf of Alaska from early April to June.

Fin whales usually breed and calve in the warmer waters of their winter range. Breeding can occur during any season, but the peak occurs between November and February (Tomilin, 1957; Ohsumi, Nishiwaki, and Hibiya, 1958).

Fin whales are opportunistic feeders, taking euphausiids, copepods, fish, and squid. They consume primarily euphausiids, which form large swarms over the continental shelf margin, where upwelling occurs (Nemoto, 1970). Fin whales also take a wide variety of fish, including herring, capelin, pollock, and Arctic cod. Their diet appears to change from year to year and from location to location, depending on whether euphausiids, copepods, fish, or squid are most abundant (Lowry et al., 1982).

(2) Humpback Whale

The present North Pacific humpback whale population is estimated at between 1,200 and 2,100 individuals (Rice 1978; Darling and Morowitz, 1986). Prior to commercial whaling, an estimated 15,000 humpbacks inhabited the North Pacific. About 28,000 humpbacks were taken by whalers, thus reducing the population to about 1,000 (Rice, 1978). However, under protection from whaling, the population may be slowly increasing.

Summer feeding grounds extend from central California and Washington State through southeast Alaska and the Aleutian Islands to the Bering Sea and southern Chukchi Sea (Wolman, 1978; Dohl, 1983). In the Bering Sea, most sightings have been recorded near Unimak Pass, the eastern Aleutian Islands, and the outer shelf east of the Pribilof Islands. In the Gulf of Alaska, concentration areas include the Portlock and Albatross Banks (off Kodiak Island) and west to the eastern Aleutians, Prince William Sound, and the inland waters of southeastern Alaska (Berzin and Rovnin, 1966).

In California, humpbacks use the Farallon Basin as a spring through fall feeding ground. The fall migration may begin as early as September for humpbacks in the northern Bering Sea (Berzin and Rovnin, 1966) and as late as December for those in the Gulf of Alaska and California (Fiscus et al., 1976; Dohl, 1983).

Humpbacks are known to winter in three areas--along central Mexico and Baja California; in the Hawaiian Islands; and in the western Pacific around the Mariana, Bonin, and Ryukyu Islands, and Taiwan. Most humpbacks that summer in southeast Alaska and Prince William Sound migrate to wintering areas off Hawaii (Darling and McSweeney, 1983). Whales that summer in central California appear to winter off Baja Mexico (Dohl, 1983; Urban et al., 1987). Photo-identification also indicates that some humpbacks migrate between winter/breeding grounds in Mexico and summering areas in southeast Alaska.

During the spring, humpback whales migrate north from overwintering areas to summer areas in the Bering Sea, the Gulf of Alaska, and the Pacific coast of North America. Humpbacks have been sighted as early as March off southeast Alaska, and in May off the Portlock and Albatross Banks and in Prince William Sound in May. They reach Bristol Bay (Cape Newenham area) in June and enter the Chukchi Sea from July to September (Tomilin, 1957).

Breeding and calving occur on the wintering grounds. Most births occur between January and March (Johnson and Wolman, 1984).

Humpbacks feed on crustaceans such as euphausiids, amphipods, mysids, and small schooling fish including Pacific herring, capelin, anchovies, sardines, cod, and sand lance (Tomilin, 1957; Wolman, 1978; Wing and Krieger, 1983). They are thought to feed mainly during the summer period, since stomachs examined during the winter months in coastal or subtropical waters of both hemispheres are generally empty (Wolman, 1978). Feeding occurs at the surface or in the midwater regime. Humpbacks capture food items by engulfing their prey or by laterally feeding at the surface.

d. Right, Blue, Sei, and Sperm Whales

(1) Right Whale

In the eastern Pacific Ocean, right whales occur from Alaska and the Aleutian Islands south to Oregon and California (Tomilin, 1957). Right whales were hunted nearly to extinction by commercial whalers during the 1800's; despite protection, the population has yet to show any signs of recovery. Over the past 30 years, 32 to 36 right whales have been sighted in the central North Pacific-Bering Sea, and 21 to 26 on the west coast of North America south of Kodiak, Alaska. The current size of the North Pacific population is unknown. Due to limited sighting information, no reliable estimate is possible; however, the sighting records suggest that there are probably only a few hundred individuals remaining.

Historic whaling records indicate that right whales were taken from April through September in the Gulf of Alaska, and from August through September in the Bering Sea/Bristol Bay area. Between spring and fall (April-September), right whales are generally found north of 50° N. latitude, particularly in the Gulf of Alaska, and roughly between 145° W. to 151° W. longitudes (Berzin and Rovnin, 1966). When in the Bering Sea, the whales are likely to be found in an area bounded by Atka, St. Matthew, and Nunivak Islands (Berzin and Rovnin, 1966).

The migration routes and winter distribution of the right whale population is unknown and subject to speculation. After examining virtually all available sighting data, Scarff (1986) hypothesized that right whales summering in the eastern North Pacific mate, calve, and overwinter in the mid-Pacific or western North Pacific. A few individuals overwinter off the Pacific coast of North America.

Right whales to feed primarily on calanoid copepods, and secondarily on euphausiids, which they skim from the upper portions of the water column.

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(2) Blue Whale

The most recent estimate of the North Pacific blue whale population is about 1,600 individuals (Gambell, 1976); however, there has been little new information on blue whale abundance since hunting ceased in 1967. It is estimated that prior to exploitation by commercial whaling there were about 4,900 blue whales in the North Pacific. There have been numerous sightings in the last several years off Mexico and California, but no useful census data are available for population assessment. There is no evidence that the blue whale stocks in the North Pacific are recovering, given the following factors: the relative scarcity of blue whales based on opportunistic sightings, the low population estimates relative to their initial abundance, and the low intrinsic rate of increase noted for this and other baleen whale populations, to date, (Mizroch, Rice, and Breiwick, 1984a).

Summering blue whales are present from the waters off California to Alaska. In southern California, Dohl et al. (1978) observed a total of 83 animals in 29 sightings. Thirty-five percent of the animals were recorded in the spring quarter (April, May, June), 49 percent in the summer quarter, and 16 percent in the fall quarter. No animals were sighted during the winter. The greatest number of sighted blue whales traversed the outer edge of the southern California Bight between the Santa Rosa-Cortes Ridge and Tanner-Cortez Banks, especially between July and October. They also were frequently sighted in waters near the southern California Channel Islands during the same months, occasionally within 28 km of the mainland.

The blue whale is a common summer/autumn visitor to central and northern California; although, in some Eyears, whales may arrive as early as May and remain until mid-December (Dohl, 1987). During 1980 to 1983 in northern and central California, most blue whale sightings occurred in waters over the continental shelf and slope (45-999 fathoms); all but one of the 66 animals were south of Fort Bragg (Dohl, 1984). Blue whales also have been seen "far off the coast of northern California . . . At least some of their movements, then must occur along pelagic routes." (Leatherwood et al., 1982). Blue whales are most commonly sighted off the Oregon coast from May through June, and August through October (Rice, 1974).

Modern whaling data indicate that blue whale abundance peaks in the eastern Gulf of Alaska in July and near the eastern Aleutian Islands in June (Rice, 1974). Compared to other large cetaceans, the blue whale migration is more limited in northern waters. Marking studies revealed little apparent movement of blue whales while they were on their feeding grounds (Morris, Alton, and Braham, 1983). The species occur in relative abundance in a narrow area just south of the Aleutian Islands from 160° W. to 175° W. longitude (Berzin and Rovnin, 1966; Rice, 1974). Also, it is distributed in an area north of 50 ° N. latitude, extending from southeastern Kodiak Island across the Gulf of Alaska and from southeast Alaska to Vancouver Island (Berzin and Rovnin, 1966). According to whaling records, large concentrations of this species once occurred in two areas: (1) the northern part of the Gulf of Alaska southwest of Prince William Sound in the Portlock Banks area (Nishiwaki, 1966), and (2) to a lesser extent, in an area west of the Queen Charlotte Islands and southeast Alaska (Berzin and Rovnin, 1966). Recent blue whale sightings in Alaskan waters have been scant.

Blue whales usually begin to migrate south out of the Gulf of Alaska by September (Berzin and Rovnin, 1966). Migration routes are thought to be along the western coast of North America. The North Pacific blue whale population winters from the "open waters of the midtemperate Pacific south at least to 20° N." Blue whales occur up to 1,300 to 2,800 km offshore of Central America and at least as far south as Panama (Leatherwood et al., 1982).

According to Berzin and Rovnin (1966), the northward spring migration of the North Pacific population begins in April through May, with whales traveling along the American shore of the Pacific. Blue whales are sighted off Baja California and the Mexican mainland in February, with peak densities apparently occurring in April.

Mating and calving are believed to take place over a 5-month period during the winter (Mizroch, Rice, and Breiwick, 1984a).

On their summer range, the principal food of blue whales is small euphausiid crustaceans *(Euphausia pacifica* and *Thysanoessa spinifera*) (Nemoto, 1959; Berzin and Rovnin, 1966) which they obtain by engulfmen.

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(3) Sei Whale

The most recent estimates of the North Pacific sei whale population range from 22,000 to 37,000 individuals. This is down from the pre-exploitation population estimate of 45,000 (Ohsumi and Fukuda, 1975). Commercial whaling catches of sei whales in the North Pacific and Bering Sea rose sharply during the 1960's and then dropped sharply thereafter. Despite protection from commercial whaling, there are no indications of population trends for this species.

Sei whales are more common in pelagic temperate waters and only occasionally venture into the Bering Sea. They apparently migrate to lower latitudes in winter and to higher latitudes in summer. Sei whales have been reported in the Gulf of Alaska and along the Aleutian Chain during the summer (Wada, 1981), with most found south of the Aleutians and off the eastern Kamchatka Peninsula to the Commander Islands (Nasu, 1963).

The southward migration begins in August or September. During late summer and early fall, sei whales are usually present in considerable numbers off central California. During January through March, most are found between 20° N. to 23° N. latitudes, but they range from Point Piedras Blancas, California (35° N. latitude), to the Revillagigedo Islands off Baja California (18° N. latitude).

Sei whales breed and calve in the warmer waters of their winter range. Most breeding occurs from October to March, with a peak in late December; calving occurs from September to February, with a peak in November (Masaki, 1976).

Sei whales feed while skimming surface waters and generally do not dive deeply. Kawamura (1980) summarized the foods of approximately 12,000 sei whales collected in the North Pacific and found that copepods comprised 83 percent of the diet, followed by euphausiids (13%), fish (3%), and squid (1%).

(4) Sperm Whale

The number of sperm whale individuals in the North Pacific population large enough to be commercially exploitable--males aged 11 years and older and females aged 10 and over--has been estimated at around 274,000 (International Whaling Commission, 1979). This is in comparison to an estimated initial (1910) population size of 310,000. Commercial whaling took many sperm whales. A worldwide average of over 20,000 sperm whales were taken annually between 1956 and 1976, thus resulting in a population decline. Although commercial whaling for sperm whales has ceased in the North Pacific, there have been no recent population trends identified for this species.

In the eastern North Pacific, sperm whales range from the equator occasionally north to 62° N. latitude and west to Cape Navarin in the Bering Sea. Sperm whales generally are found in waters of 200 m or deeper, and typically only males venture north of 50 °.latitude. Sperm whales migrate poleward in spring and summer, returning to the temperate and tropical portions of their range in the fall.

During the summer months, male sperm whales are present in the Bering Sea, where they are generally encountered singly or in pairs. Summer feeding grounds occur off British Columbia, the Gulf of Alaska, the Alaska Peninsula, and the Aleutian Islands. In the Bering Sea, sperm whales most commonly occur along the shelf break between the Pribilof Islands and Cape Navarin. Ohsumi (1965) and Best (1975) estimated that 40 to 60 percent of the mature males (20% to 30% of the entire mature population) spend the summer months at high latitudes (the Bering Sea and Aleutian Islands areas). Fall migrations begin in September, and most whales have left Alaskan waters by December.

Off central and northern California, sperm whales are present year-round in offshore waters. Peak abundance has been observed during May through June, and August through November as the whales migrate through the area (Gosho, Rice, and Breiwick, 1984). The wintering grounds are generally south of 35° N. latitude, between the Hawaiian Islands and California. Migration northward to Alaskan waters begins in March and continues through May (Berzin and Rovnin, 1966).

Breeding occurs during the spring and early summer--April through August. Calves are born after a gestation period of about 15 months (Gosho, Rice, and Breiwick, 1984).

Sperm whales feed predominantly on squid and fish, on the bottom as well as in midwater regions

2. Nonendangered Cetaceans

a. Beluga Whale

The beluga whale is a circumpolar species in arctic and subarctic waters. At least 15,800 to 18,450 individuals are estimated to summer in the coastal waters off Alaska and western Canada (Hazard, 1988). The reliability of abundance estimates varies greatly among the summering areas, and overall population trends are unclear. Bristol Bay is the only area in which surveys have been thorough enough to provide a baseline for evaluating population trends. Declines in abundance have been reported, although it is not known whether these represent a shift in the distribution or a decline in population size. Hunting appears to have the most clear and direct affects on the beluga population. The trend in the number of belugas harvested shows fewer whales being taken in recent years (Hazard, 1988). This should bode well for the overall population.

In waters off Alaska, belugas occur in the Cook Inlet/Gulf of Alaska area and in the Bering, Chukchi, and Beaufort Seas. Belugas in the Cook Inlet/Gulf of Alaska area appear to be year-round residents (Calkins, 1983) and do not appear to intermix with individuals from other populations (Sergeant and Brodie, 1969).

The major migratory group of beluga whales in Alaskan waters is the Bering Sea population. Individuals from this population winter over a broad area in the Bering Sea and summer in Bristol Bay, Norton Sound and the Yukon Delta, the Chukchi Sea including Kotzebue Sound and waters in and adjacent to Kasegaluk Lagoon, and the eastern Beaufort Sea including the Mackenzie River Delta and Amundsen Gulf. The fidelity of individuals to summering areas and the degree of overlap in wintering areas is unknown. An estimated 1,000 to 1,500 belugas summer in Bristol Bay, 1,000 to 2,000 summer in Norton Sound and the Yukon River Delta, 2,000 to 3,000 summer in the Chukchi Sea, and 11,500 summer in the eastern Beaufort Sea.

After spending the summer months in coastal areas or associated with the offshore pack ice in the western Beaufort and northern Chukchi Seas, the belugas begin to migrate southward in the fall. Most belugas leave the southeast Beaufort Sea by mid-September (Davis and Evans, 1982). The peak migration out of the Beaufort Sea occurs before October, primarily well offshore. After entering the Chukchi Sea, belugas move southward as the pack ice advances. Most arrive in the vicinity of St. Lawrence Island in the northern Bering Sea in November and December. In March, April, and May as leads form and the pack ice melts, belugas move from the offshore Bering Sea wintering area toward coastal summering areas (Braham and Krogman, 1977; Seaman and Burns, 1981). Northward migrating belugas enter the Bering Strait during March through July. From the Bering Strait, belugas, bound for the eastern Beaufort Sea, follow leads along the northwest Alaska coast, round Point Barrow, and head east toward Banks Island, Canada, through a system of recurring leads far offshore (Fraker, Sergeant, and Hoek, 1978; Braham, Krogman, and Carrol, 1979). Spring migrants reach Banks Island in May and June.

As the ice retreats in June and July, belugas move in a second wave along the northwest coast of Alaska into Kotzebue Sound and the waters off Kasegaluk Lagoon. Belugas also arrive in inner Bristol Bay, Norton Sound, and the Yukon River Delta as the ice retreats (Hazard, 1988). The absence of sightings seems to indicate that few, if any, belugas remain in their wintering areas in offshore waters of the Bering Sea (Harrison and Hall, 1978; Leatherwood, Bowles, and Reeves, 1983).

Breeding appears to occur in the late winter and early spring. Calving occurs in all Alaskan coastal waters where belugas aggregate in summer. March through September constitutes the calving season with a peak in June and July, although some calving occurs prior to or during the spring migration (Hazard, 1988).

The diet of beluga whales is quite varied; over 100 kinds of organisms have been identified as prey items (Kleinenberg et al., 1964). Fish are the dominant food item in coastal areas of Alaska in summer (Lensink, 1961; Seaman, Lowry, and Frost, 1982); squid, octopus, and other invertebrates are also important at various times of the year.

b. Minke whale

Minke whales (*Balaenoptera acutorostrata*) are widely distributed, occurring from the Bering and Chukchi Seas south to at least near the equator (Leatherwood et al., 1982). Population size in the Alaska/Pacific Regions is unknown (Department of Commerce (DOC), 1987). In the summer, minke whales appear to be broadly distributed between Baja California and the Chukchi Sea; in the winter, their range is more compressed, extending from Islas Revillagigedo, Mexico, into central California (Rice, 1974).

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Although they have a wide distribution, minke whales are not considered abundant in any part of the North Pacific except Alaska. Little is known of their population size. Historically, these whales were not actively hunted due to their small size relative to other baleen whales. Current population numbers come from annual catches by Japanese and Korean whalers from the Okhotsk Sea-West Pacific stocks. (Minkes in the northeastern Pacific are protected from whaling.) Between 1954 and 1982, 22,746 minke whales were killed in the northwest Pacific. Based on this catch-per-unit effort and historical catches of minkes, the size of the west Pacific stock was estimated in 1981 to contain 17,000 to 28,000 animals. The northeast Pacific population probably contains similar numbers.

These animals are present in Alaskan waters primarily during the summer. No reliable population estimates exist for these whales; however, they are considered common in the waters along the eastern Aleutians during that season.

Minke whales are relatively uncommon in central and northern California waters but have been sighted during all seasons; 71 percent of the sightings recorded in that area by Dohl et al. (1983) occurred from May through October. Overall, Dohl et al. (1983) reported that minke whales range along the outer edge of the continental shelf, and only rarely move inshore. Two of the four relatively low concentrations of minke whales observed by these investigators occurred within the northern California area, from San Francisco Bay to Point Arena, and from Cape Mendocino to Trinidad Head.

Repeated observations by other investigators of photo-identified individuals in northern Puget Sound suggest that some whales may reside there year-round. The seasonal variability of sightings of minkes suggest that these animals are migratory like other baleen whales; however, no tagging data exist to support this hypothesis. Current belief is that the population as a whole shifts north in summer and south in winter, while some animals in temperate areas remain year-round.

Minke whales have been observed as individuals, pairs, or small groups along the California coast (Dohl et al., 1978), and occasionally congregate in larger groups in more northern latitudes with high food concentrations during spring and summer (Leatherwood et al., 1972). Minke whales breed in temperate or subtropical waters, and there is some evidence that calving occurs in southern California (Dohl et al., 1978). Parturition occurs in winter and spring.

c. Harbor porpoise

Although harbor porpoises (*Phocoena phocoena*) are frequently observed in bays, harbors, and river mouths, they primarily inhabit open, unsheltered, nearshore waters from about Point Conception north to Alaska in the eastern North Pacific and are most abundant in waters from southern Alaska to Washington State (Leatherwood et al., 1982). From Morro Bay northward, they are one of the most common inshore cetaceans and are found almost exclusively within the 183-meter (100 ft) curve, with most animals being in waters deeper than 18 m (10 ft) (in most instances, within 0.3 miles of shore).

Only recently (Gaskin, 1984; Barlow, 1988) have there been comprehensive surveys of harbor porpoises on the Pacific Coast; therefore, no comparisons can be made regarding population changes.

The seasonal movements of harbor porpoises in the Alaskan/Pacific Regions are not well understood, but the porpoises are year-round residents of most areas. Any major seasonal shifts in distribution are believed to be as likely inshore-offshore as north-south.

This cetacean is fairly common along much of the Gulf of Alaska shoreline and the eastern Aleutians. Prince William Sound (off Valdez, AK) may have the highest concentration in winter than anywhere in the eastern Pacific. Harbor porpoises are rare in northern Alaska and are considered uncommon north of Bristol Bay.

Barlow (1988) estimates the population of harbor porpoises to be 46,000 in exposed coastal areas (but excluding several unexposed coastal bays) from Cape Flattery, Washington, to Point Conception, California. The California population is estimated at 10,000 individuals, of which about 82 percent are found north of Monterey Bay (DOC, 1987). Offshore surveys conducted statewide by Dohl et al. (1978, 1983) found this species to be most common in the Northern California Planning Area. Over the 3 years of the central and northern California surveys, 66.5 percent of the recorded sightings occurred in nearshore waters north of Point Arena. Most sightings occurred less than 0.5 km from the shoreline, although occasional sightings occurred offshore in the Gulf of the Farallones (40 km from shore) and off Point St. George (70 km from shore).

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Although most small cetaceans occur in associations with other species, the harbor porpoise is usually observed alone, in pairs, or in very small groups (Dohl et al., 1983). Newborns appear between May and July following a gestation period of 10 to 11 months (Dohl et al., 1983). Dohl et al. (1983) observed juveniles during most of the year, although with reduced frequency in the spring and early summer months.

Being inshore animals, harbor porpoises are particularly vulnerable to the impacts of human activities. Harbor porpoise mortality due to entanglement in gill nets has been documented in Monterey Bay and in the Gulf of the Farallones. From 1983 through 1985, an estimated 814 harbor porpoises were taken in gill and trammel nets in the area between Yankee Point in Monterey County and the Mendocino-Sonoma County line (California Department of Fish and Game, 1987). NMFS has initiated studies to determine the impact of set-net fisheries on population centers of harbor porpoises in California (Miller et al., 1982; DeMaster et al., 1985).

3. Pinnipeds

a. Northern Fur Seal

Northern fur seals are highly migratory and widely dispersed in pelagic waters of the North Pacific during the nonbreeding season (November to May or June), with various age- and sex-class segments of the population found from the southern Bering Sea south to California. Most adults spend the remainder of the year on the Pribilof Islands or foraging in the vicinity. This discussion summarizes and incorporates by reference the description of northern fur seals contained in the St. George Basin Sale 89 FEIS (DOI, MMS, 1985).

The northern fur seal population is estimated to be about 1.2 million (Fowler, 1985a). Of these, about 827,000 comprise the Pribilof Islands population (Zimmerman, pers. comm., 1987). About 4,000 are associated with San Miguel Island off Santa Barbara, California, and a small breeding group (1988: about 80 pups born) has established itself on Bogoslof Island, north of Umnak Island in the Aleutians. The remainder of the population breeds on islands off the coast of the U.S.S.R. Some mixing of North American and Russian stocks occurs (McAlister, 1981). From 1975 to 1981, the Pribilof population has declined at an estimated rate of about 4-8 percent per year (Fowler, 1982, 1985b). Since 1981, there has been no statistically significant trend (York and Kozloff, 1987). However, this species has been designated as depleted under the Marine Mammal Protection Act. Although the specific causes of population decline have not been determined, the most likely factors are increased mortality at sea, including entanglement in net fragments, and a suboptimal age- and sex-ratio in the population resulting in decreased productivity (Fowler, 1985a).

In general, chronology of the northern fur seals' return to the Pribilofs reflects the distance at which they winter from the islands. One large wintering concentration has been noted off Baranof Island in southeast Alaska, and individuals have been observed on Portlock Bank near Kodiak Island, and in the central Gulf of Alaska (Consiglieri and Braham, 1982). Northward migration of older females from California waters begins in March, and from April to mid-June, large numbers of males and females of all ages are found throughout coastal Gulf of Alaska and eastern Aleutian passes. Many females and young males follow a direct route across the gulf from the Pacific northwest to Kodiak Island and the eastern Aleutians (Bigg, 1982; Fiscus, 1978). Breeding-age males that have overwintered in the southern Bering Sea or western Gulf of Alaska return to the islands in late April and May, followed progressively by females and younger individuals from June through September or October. For the first 1 or 2 years, most individuals remain at sea in coastal waters. Pups are nursed by the females for 3-4 months at 9- to 12-day intervals following their return from pelagic foraging trips. Females typically forage over the outer continental shelf and slope within 160 km of the islands, but also as far as 400 km away (Harry and Hartley, 1981). This range incorporates the eastern Aleutian passes and also extends northwestward along the shelfbreak to at least 175° W. longitude. Males abandon their territories by mid-August, hauling out elsewhere on the islands or returning to sea. Most northern fur seals begin their fall migration in late October and November, proceeding through the eastern Aleutian passes and following the edge of the continental shelf around the Gulf of Alaska and southward.

b. Steller Sea Lion

Steller (northern) sea lions occur over the continental shelf throughout the Bering Sea and Gulf of Alaska, south to San Miguel Island in southern California (Burns, Frost, and Lowry, 1985). This discussion summarizes and incorporates by reference the description of Steller sea lions contained in the St. George Basin Sale 89 FEIS (DOI, MMS, 1985).

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The total Steller sea lion population is estimated at about 231,000, including 2,200 in the Pribilof and St. Matthew Islands, 2,000 in Bristol Bay, 89,000 in the Aleutians Islands, 91,000 in the Gulf of Alaska, and 12,000 in southeast Alaska (Loughlin et al., 1984). The remainder are found along northwest Pacific coasts, south to southern California. Their population in the eastern Aleutians exhibited a decline of about 50 percent between the late 1950's and the late 1970's (Braham et al., 1980) and has continued declining at a rate of 7 percent per year since then (Loughlin et al., 1986; Merrick et al., 1987), resulting in a decrease from about 50,000 to 10,000 individuals in this area. Although the possible causes of this decline have not been evaluated adequately, it is likely that factors contributing to decreased productivity are responsible since there is little evidence of increased emigration or mortality from this area (Lentfer, 1988). Though adequate information is lacking, factors potentially responsible for the decline include changes in the abundance of the size prey thought to be preferred by sea lions, and the presence in the Alaska population of two disease organisms that could cause reproductive failure and mortality (Merrick et al., 1987).

Sea lion rookeries in Alaska are located on the Pribilof Islands, on Amak Island north of the Alaska Peninsula, throughout the Aleutian Islands and western Gulf of Alaska to Prince William Sound, and on Forrester Island in southeast Alaska. Nearly half of the world's sea lion pup production is estimated to occur at four rookeries in the western Gulf of Alaska. Haulouts areas are numerous throughout the breeding range, and some are used in the northern Bering Sea as well. Males and subadults of both sexes haul out at many locations not used as rookeries, and many rookeries are occupied year-round. Mature males begin arriving at the rookeries in early May, preceding the arrival of females. Pupping lasts from mid-May until mid-July. Nursing females alternate periods on land of 1-3 days with foraging bouts at sea averaging less than 24 hours (Gentry, 1970).

Sea lions are not noted for undertaking migrations comparable to that of the fur seal, but there are definite dispersals throughout their range following the breeding season, including a regular late-summer-early-fall movement of 1,000 or more males to St. Lawrence Island and the Bering Strait, and movement of males from California north to haulouts in Oregon, Washington, Canada, or southeast Alaska (Burns et al., 1985). Movements of sea lions in the Gulf of Alaska, especially juveniles, have been documented extensively. These include movements among the Barren Islands, Chirikof Island, islands along the Kenai Peninsula, Prince William Sound, southeast Alaska, and British Columbia. Movement of males from the Aleutian Islands to the ice front in the central Bering Sea apparently occurs in winter and spring (Lowry et al., 1982).

c. Guadalupe Fur Seal

The Guadalupe fur seal (*Arctocephalus townsendi*) was listed as threatened in 1985 by NMFS. These animals are known to breed only on Guadulupe Island offshore central Baja California, Mexico. The breeding season extends from May to late July. In 1984, 1597 animals were counted on the Island (Seagars, 1984). This count is still considered the most reliable count of this species.

In the Pacific Region a few non-breeding individuals have been seen on San Miguel Island each year since 1969 during the breeding season (Seagars, 1984). The number of seals seen on the island has ranged from one to a maximum of five animals in 1978. The species has also been seen at San Nicolas, San Clemente, and Santa Barbara Islands (Stewart et al., 1985). In 1984, a female was stranded at Pillar Point, San Mateo County; and in 1988, a female as stranded near Jenner, California in Sonoma County.

No studies of the movements or migration have been conducted, but these seals are believed to spend at least part of their lives living pelagically.

d. California Sea Lion

The world population of the California sea lion (*Zalophus californianus*) (not including the population in the Galapagos) is estimated to be over 157,000 animals (DOC, 1987). They presently range from British Columbia (Bigg, 1973) to Acapulco, Mexico (Gallo-R. and Ortega-O., 1986).

Total population growth estimates, based on pup production records, are reported to be about 7 percent, representing a potential doubling of the population every ten years (Bonnell et al., 1983). As a result of increased numbers, animals are also expanding their range. Sea lions are becoming common offshore the Pacific Northwest where they were almost unheard of before the 1970's.

In the Pacific Region, the California sea lion is the most abundant pinniped on land and in waters over the continental shelf (<200 m). It breeds in the summer on islands from the Gulf of California in Mexico to the Channel Islands in southern California. Although a few pups have been born on Ano Nuevo Island (Keith et al., 1984) and Southeast Farallon Island (Pierotti et al., 1977) in recent years, viable rookeries have yet to be established north of Point Conception.

In northern California, Oregon, and Washington, California sea lions generally reach maximum abundance in the fall (September and October), when thousands of sea lions (mainly immature and adult males) disperse (some adults move as far north as British Columbia) northward from the Channel Island rookeries; a second, lower peak in abundance may occur in the spring, when animals return southward toward the rookeries. Populations in Oregon and Washington have been estimated at 6000 individuals during fall and winter. Along the California coastline north of Point Reyes, the numbers of California sea lions observed on land have varied from a few hundred in mid-summer to more than 5,500 in the fall, with 2,000-2,500 generally present through the winter and spring (Bonnell et al., 1983).

Total population growth estimates, based on pup production records, are reported to be about 7 percent, representing a potential doubling of the population every 10 years (Bonnell et al., 1983). The recently observed increases in this species abundance within the Pacific Region are thought to be attributed to the increase of the southern California breeding population.

California sea lions are the most abundant pinnipeds over the shelf (<200 m) and, except in winter and spring when their numbers are surpassed by migrating northern fur seals, over the slope (200-2,000 m) as well. Bonnell et al. (1983) observed highest densities of California sea lions in northern California waters in the fall. Most of the sea lions sighted during all seasons (57 percent) were over the shelf.

e. Other Pinnipeds

(1) Northern Elephant Seal

Prior to the commercial harvesting of the 1800's, the range of the northern elephant seal (*Mirounga angustirostris*) extended from Point Reyes, California, (just north of San Francisco) to Cabo San Lazaro, Mexico. The species was thought to be extinct until 1892, when a small population of no more than 100 animals was discovered on Isla de Guadalupe, off Baja California. The present breeding range of the northern elephant seal extends from Isla Natividad in Baja California to Point Reyes in northern California (Bonnell et al., 1983; Allen et al., in press). (The largest rookeries are, in descending order, Ilsa de Guadalupe, San Miguel Island, Ilsa San Benito, Ano Nuevo Island, and San Nicolas Island.) Population size is estimated at 100,000 (DOC, 1987). Cooper and Stewart (1983) estimates that the population has been doubling every 5 years since the early 1960's.

Northern elephant seals are present in the Pacific Region year-round. They spend most of their time well offshore, feeding at depths of 350 to 650 meters (.2 to .4 miles), with only 14 percent of their time being spent on the surface (Le Boeuf et al., 1987). They return to the rookeries to breed in late December to early March. Females give birth about a week after they arrive. They nurse pups until they are about 1 month old. While on the rookeries, animals abstain from food and water until after the breeding season. (In spring, females and juveniles return to molt; males return in the summer.)

Over 90 percent of the breeding population occurs south of Point Conception. Ilsa de Guadalupe and San Miguel Island produce some 28,000 and 17,000 pups/year, respectively, which make up about 75 percent of the year's production.

The most northern rookeries occur at Ano Nuevo Island, Point Reyes (the species' largest rookery north of the Channel Islands), Southeast Farallon Island, and Point Reyes. In 1986, approximately 2,200 pups were born on these three or four rookeries (Pierson and Le Boeuf, 1987; Huber et al., in press). Point Reyes, where 19 pups were born in 1986, is now the northernmost established elephant seal rookery. Few elephant seals are sighted on land north of Point Reyes.

No specific patterns of migration have been documented; however, tagged animals are known to disperse from rookeries to the north, some as far north as the Gulf of Alaska.

(2) Harbor seal

Along the west coast of North America, the range of the harbor seal (*Phoca vitulina*) extends from Alaska south to Baja California. The harbor seal is a year-round resident of the Alaskan/Pacific Region Coasts, hauling out on islands, estuaries, secluded beaches, and offshore rocks along the length of the coastline (Bonnell et al., 1983; Hanan et al., 1987). The most recent estimate of the population size is 320,000 animals, of which 42,000 (14 percent) are south of Alaska (DOC, 1987).

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In coastal Alaska, harbor seals are found from Kuskokwim Bay through southeast Alaska. They are generally considered sedentary, and long-range movements are uncommon. Seals in Kuskokwim and Nanvak bays, however, do move south of the ice pack to the Alaskan Peninsula to winter, and some disperse following the breeding season and have been known to move some 550 km (340 mi) (Hoover, 1988).

Based on censuses performed from 1982-1986, the harbor seal population in California appears to be stable. The NMFS estimates that the population in Oregon has increased by 7 percent annually since 1977 and about 10 percent annually in Washington since 1976 (DOC, 1987).

The picture in Alaska is less clear, however. Hoover (1988) presents a discussion on the problems of obtaining quantitative data on seals in Alaska and summarizes information on the population trends. In summary, it appears that the populations along the northern Alaskan Peninsula (Hope Basin Planning Area) and on Tugidak Island (in Kodiak Planning Area) are declining. However, the population in the Gulf of Alaska is believed to be increasing. Populations elsewhere are presumed to be stable.

Peak harbor seal populations on land occur during the species' spring breeding and pupping season and early summer molt. Following the breeding and pupping season, harbor seals disperse along the coast and spend more time at sea throughout the fall and winter.

Harbor seals forage close to shore and are seldom seen in waters deeper than 200 m (Bonnell et al., 1983). Although a few animals were seen as far as 46 km from land (Bonnell et al., 1983), most (91 percent) were sighted within 20 km of the coastline.

4. Polar Bear

Polar bears are most abundant around the perimeter of the polar basin in association with drifting pack ice or shorefast ice where seals are common. Although they have been recorded as far south as St. Matthew, Nunivak, and the Pribilof Islands in the Bering Sea, they regularly occur only as far south as the Bering Strait and St. Lawrence Island (Lentfer, 1972). Available information suggests Alaska has two relatively discrete polar bear populations: one in the Beaufort Sea and one in the Chukchi Sea, with the boundary in the vicinity of Pt. Barrow. However, there is relatively little interchange of individuals between the two groups. Those in the Chukchi Sea make extensive north-south migrations in relation to the pack ice edge (Amstrup and DeMaster, 1988). Bears are most abundant along the Alaskan coast in years when winds drive old ice near shore. As the ice edge recedes northward in spring and early summer, the bears move north with it. Mature males are generally found further north than subadults and females with cubs which occupy drifting ice and the floe edge. Females with cubs also may occupy shorefast ice, although this appears more characteristic of those in the Canadian Beaufort. As ice forms in the fall, bears from the drifting ice move generally southward and become distributed along the coast by late fall.

Low polar bear densities preclude accurate estimates of population size at the present level of survey effort; currently, the most accepted estimate for the total Alaskan population is 3,000-5,000 (Amstrup et al., 1986). Probably as a result of restricted hunting, polar bear populations are thought to be similar to those of the 1950's and may be increasing in some areas.

Females enter maternity dens excavated in snow by late November and usually emerge, with cubs born in December or January, by late March or early April. Females are very sensitive to disturbance during this period (Lentfer and Hensel, 1980; Amstrup, 1986). Most dens are located on land near the coast or on offshore islands, on shorefast ice, or, to a lesser extent, on drifting pack ice.

C. Marine and Coastal Birds

1. Threatened or Endangered Birds

a. Arctic and American Peregrine Falcons

Based on 1988 surveys, the population of arctic peregrine falcons now stands at about 80 pairs and 120 young. The population of American peregrine falcons in Alaska is estimated at about 225 pairs (DOI, Fish Wildlife Service (FWS), 1989; Ambrose, pers. comm., 1989) while in California 64 pairs are estimated (DOI, FWS, 1986). The FWS estimates that 200 pairs of arctic and 400 pairs of American peregrine falcons historically nested in Alaska. Beginning in the late 1940's, the use of the organochlorine pesticides greatly affected peregrine falcons, causing birds to lay thin-shelled eggs which often failed to hatch, and consequently lowered reproduction. In Alaska, the population of arctic peregrine falcons declined to approximately 30 percent of historical levels. In 1978, a number of years after the United

States had restricted the use of organochlorine pesticides, the peregrine falcon population began to increase, and the trend has continued to that present.

Endangered American peregrine falcons nest on cliffs in interior Alaska, south of the Seward Peninsula and Brooks Range. Threatened arctic peregrine falcons nest in the tundra regions of Alaska, north of the Brooks Range and on the Seward Peninsula. Arctic peregrine falcon nest sites have been found on cliffs, bluffs, and low hills (DOI, FWS, Region 7, 1982). Peregrine falcon nest sites closest to the coast occur on shoreline cliffs adjacent to Norton Sound. On the North Slope, nesting sites nearest the coast occur about 25 miles inland (DOI, MMS, 1984).

Peregrine falcons are usually present in Alaska from about mid-April to mid-September. Egg laying occurs about the third week of May for interior Alaska, and the first week of June for the North Slope. The young fledge about the end of July in the interior, and about mid-August on the North Slope (DOI, FWS, Region 7, 1982). Immature arctic peregrines are known to use northern Alaskan coastal habitats east of the Colville River on a transient basis from mid-August to mid-September (DOI, MMS, 1984).

Data regarding the migration routes of Alaskan peregrine falcons are limited; however, it appears that falcons from the North Slope and eastern interior generally follow the central flyway, and falcons from the western interior follow the Pacific flyway. Migrating peregrine falcons have been seen in the Malaspina Glacier area adjacent to the Gulf of Alaska, but arctic and American peregrines probably occur in the Gulf of Alaska/Cook Inlet area only irregularly during migration (DOI, FWS, Region 7, 1982). Peregrines which occur along the California coast are probably year-round residents, although some winter movements may occur. The mouths of most major rivers and estuaries in northern California are important foraging areas (DOI, FWS, 1982).

Arctic and American peregrine falcons winter in Latin America from September to April, as far south as 40° S. latitude in Chile and 38°S. latitude in Argentina (Steullet and Deautier, 1935; cited by DOI, FWS, E1982). Wintering habitats apparently vary widely from sea level to an elevation of 10,000 feet, but all wintering areas likely include undisturbed roosting areas and an adequate avian prey base (DOI, FWS, Region 7, 1982).

Peregrine falcons feed mostly on other birds. Prey remains at coastal nest sites in Alaska indicated that shorebirds, gulls, seabirds, waterfowl, and various small land birds were taken by peregrines (Wright, 1987). Similar species were taken by peregrine falcons migrating through central Alberta, Canada (Dekker, 1980). Shorebirds, gulls, and waterfowl appear to be important food sources in a number of wintering locations (DOI, FWS, Region 7, 1982).

b. Short-Tailed Albatross

The short-tailed albatross were once abundant and widespread in the North Pacific, including coastal areas from Alaska to Baja California where upwellings brought nutrient-rich waters to the surface. Activities of feather hunters on the nesting grounds reduced the species to near extinction (Hasegawa and DeGange, 1982). Since their rediscovery as a breeding species on Torishima Island (580 km south of Tokyo, Japan) in the early 1950's, the short-tailed albatross have staged a slow comeback and now number approximately 400 individuals (H. Hasegawa, pers. comm., 1988). Protection and habitat improvement on the breeding grounds have resulted in the increased population and would appear to offer promise for a continued rise in the population.

From observations and band recoveries during the last 20 years, it appears that the short tailed albatross still occur over much of their original range but in greatly reduced numbers. Birds begin arriving at the breeding island, Torishima, in early October. Failed breeders and nonbreeders depart Torishima in winter and spring with successful breeders and fledglings departing from late May to June. Individuals probably scatter widely over the North Pacific but may concentrate in nutrient-rich waters (Hasegawa and DeGange, 1982).

Short-tailed albatrosses are surface feeders and often feed nocturnally on squid, which come to the surface primarily at night (Hasegawa and DeGange, 1982).

c. California Least Tern

Least terns (*Sterna antillarum*) migrate from Mexico each spring to establish small breeding colonies on the coast from northern Baja California to San Francisco Bay. At one time their nesting habitats formed a discontinuous band along the coast, primarily on sand ocean beaches. However, increased human activity there has made these areas largely uninhabitable so that breeding now occurs on some 20 isolated coastal areas: the majority being in southern California on military bases (Seal Beach Weapons Station and Camp Pendelton). The FWS estimated that between 1984 and 1987 there were approximately 940, 1020, 960, and 940 breeding pairs in California. (Population estimates for 1974 to 1977 were approximately 58, 600, 660, and 770 breeding pairs.)

Nesting locations are on open expanses of sand, dirt, or dried mud close to a lagoon or estuary where small fish can be obtained. Eggs are laid in mid-May to early August (FWS 1980a).

By late September, the California least terns migrate south. The migration route and winter distribution of these birds are almost unknown, as they tend to blend in with other wintering terns. (The racial differences between small terns which winter in Mexico are evident only when birds are in breeding plumage.)

d. California Brown Pelican

This species (*Pelecanus occidentalis*) breeds from the Channel Islands Marine Sanctuary (Anacapa and Santa Barbara Islands) to islands in the Gulf of California (Baja California), and on the Tres Marias Islands off Nayarit (FWS, 1980b). Listing of the California brown pelican was based primarily on serious declines observed in the southern California Bight population of this subspecies.The history of the California brown pelican's decline, due to the bioaccumulation of chlorinated hydrocarbons (DDT, DDE, dieldrin, and endrin) in the food chain and scarcity of food (i.e., anchovies), is well documented in the literature (Schreiber and DeLong, 1969; Jehl, 1973; Gress, 1970; Risebrough et al., 1971; Anderson 1977; Keith et al., 1971; Anderson et al., 1975; and Anderson and Gress, 1983) and is summarized in the Brown Pelican Recovery Plan (DOI, FWS, 1982).

Pelicans are now successfully breeding on both Anacapa and Santa Barbara Islands in the Channel Islands Marine Sanctuary. The Coronados colonies have not been successful during the past few breeding seasons (Harlow, DOI, FWS, pers. comm. 1987).

Preferred nesting habitats of the California brown pelican are on offshore islands, although some individuals nest in mangroves along the Mexican coast. In 1986, the southern California Bight breeding population was estimated at 7,400 pairs (Harlow, DOI, FWS, pers. comm. 1987).

After the major breeding season (January-April), birds disperse along the California, Oregon, and Washington Coast. Large numbers of pelicans begin appearing north of the breeding colonies by July, staying through September.

Briggs et al. (1983) observed approximately 24,000 post-breeding birds ashore and at sea in north and central California in July of 1980 and 1982, and 33,000 in 1981. The Gulf of Farallons is particularly important to post-breeding pelicans. During this time, approximately 50 percent of the population may occur on the coastal waters between Bodega Bay, Marin County, and Monterey Bay (Anderson, pers. comm. 1987). Up to 6,000 pelicans may use the Farallon Islands to roost during the summer.

Briggs et al. (1987b) estimated that 70-80 percent of the maximum Statewide pelican population occurred south of Point Conception during September or October. Briggs estimated the total pelican population to be as high as 80,000-110,000.

There have been no systematic surveys of the post-breeding pelican population of Oregon and Washington. Post-breeding birds have distinct requirements for daytime versus nighttime roost. Night roosts are usually in regions with high oceanic productivity and are isolated from predation pressure and human disturbance. Requirements for daytime roost are less restrictive, and therefore, birds are found in more varied locations (Jacques and Anderson, 1987).

Since brown pelicans feed by plunge-diving from 15 to 20 meters above the surface, their feeding activities are limited by turbidity of the water below. The major food item of these birds is small schooling fish (primarily anchovies) (DOI, FWS, 1982).

2. Nonendangered Birds

a. Geese

Ten species or subspecies of geese (excluding the endangered Aleutian Canada) breed and/or migrate in the Alaska region (Bellrose, 1980). These include the white-fronted, tule, lesser snow, emperor, dusky

Canada, Vancouver Canada, lesser Canada, cackling Canada, Taverner's Canada, and Pacific black brant. Most nest in coastal Alaska and Canada and migrate to wintering areas in the western United States and Mexico. Migration corridors include inland, coastal, and offshore routes. Major nesting concentrations occur on the Yukon-Kuskokwim (Y-K) Delta and the arctic slope. Certain areas on the arctic slope, lagoons and bays of the Beaufort, Chukchi and Bering Seas and Y-K Delta, the north side of the Alaska Peninsula, and several areas in the Gulf of Alaska are important molting and/or staging areas prior to migration.

Until recently, populations of four geese (white-fronted, emperor, cackling Canada, and black brant) that breed principally on the Y-K Delta had declined more or less steadily from high levels recorded in the mid-1960's. The Yukon-Kuskokwim Delta Goose Management Plan may account for the more favorable recent trends in these populations, by having provisions that seek to eliminate egg gathering, curtail hunting during the nesting through molting periods, and prohibit hunting of any of the four species noted above when their populations fall below a management threshold. However, since the implementation of a management plan with strict regulation of subsistence and sport harvests, these populations appear to be stabilizing or even increasing somewhat (FWS, pers. comm., 1989.

(1) White-fronted Goose

From a high point of about 500,000 in the mid-1960's, the Pacific flyway white-fronted goose population declined to about 90,000-100,000 by 1976 where it remained until 1986 (FWS, per. comm., 1989). The population has increased over the past 2 years, and is presently estimated at 161,500. Probable factors responsible for the decline include excessive harvest of birds and their eggs on the breeding grounds, excessive harvest in migration and wintering areas, and declining availability of suitable winter habitat (i.e., only 4% of the original wetlands of California's Central Valley remain, and certain agricultural land uses reduce suitable habitat still further and may result in increased disease mortality). Adverse weather conditions that delay nesting also can have a major effect, and an increasing level of disturbance on the Y-K delta has a similar long-term potential.

About 95 percent of the whitefronts that winter in the Pacific region nest on the Y-K Delta, occupying a variety of tidal to upland habitats as dispersed pairs from May to August. Most of the remainder nest in the Innoko River Valley and Bristol Bay lowlands, with small numbers nesting in the interior and on the arctic slope. Beginning in August, most delta whitefronts migrate directly across the North Pacific to staging areas in the Klamath Basin in Oregon and northern California. A small proportion follow a coastal route with stops in northern Bristol Bay, Upper Cook Inlet, Copper River Delta, and several other areas in southeast Alaska, British Columbia, Washington, and Oregon; a few of these follow a route inland of the coastal mountains. Most eventually move to wintering areas in California's Central Valley in late October. Small concentrations overwinter in central highland and West Coast areas of Mexico, and about 10 percent of the population has occupied the Klamath Basin in recent winters. Spring migration in April an May essentially retraces the coastal and inland portions of the fall route.

(2) Emperor Goose

From a high point of about 139,000 in the mid-1960's, the emperor goose population declined to about 42,000 by 1986 (DOI, FWS, pers. comm., 1989). The population has increased slightly over the past 2 years, and is presently estimated at 53,800. Probable reasons for the decline include excessive harvest of birds and their eggs on the breeding grounds and excessive harvest in migration and wintering areas. Adverse weather conditions that delay nesting also can have a major effect, and an increasing level of disturbance on the delta and Alaska Peninsula has a similar long-term potential. The Yukon-Kuskokwim Delta Goose Management Plan may account for the more favorable recent trends in these populations, by having provisions that seek to eliminate egg gathering, curtail hunting during the nesting through molting periods, and prohibit hunting of any of the four species noted above when their populations fall below a management threshold.

Virtually the entire emperor goose population is restricted to the Bering Sea region. An estimated 80-90 percent of Alaskan emperors breed on the Y-K Delta, nesting in loose colonies in tidal grassland, lowland tundra, and marsh habitats within several hundred yards of tidewater (although this may extend 30-40 miles inland along tidal streams). Small numbers nest adjacent to other Alaska OCS planning areas on Nunivak Island, near Shishmaref on the Seward Peninsula, and near Kivalina north of Kotzebue. In the U.S.S.R., emperors nest along the coast of the Gulf of Anadyr and Chukotsk Peninsula. Nesting begins in late May and early June. Substantial numbers of subadult emperors and failed breeders from the Y-K Delta and U.S.S.R migrate to St. Lawrence Island in mid-June to molt; apparently, few nest on the island.

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Most emperors migrate from the delta across Bristol Bay to lagoons on the north side of the Alaska Peninsula in late August and September, most arriving by early October. From there they spread throughout the Aleutian Islands in November and December. A small percentage migrate from the Y-K delta to winter on Kodiak Island. Emperor geese begin moving eastward along the Aleutians in March, congregating prior to breakup along the north side of the Alaska Peninsula in April, arriving on the Y-K delta in May. Spring migration to Soviet breeding areas proceeds along the Alaska coast and through the Bering Strait.

(3) Cackling Canada Goose

From a high point of about 384,000 in the mid-1960's, the Pacific flyway cackling Canada goose population declined to about 19,000 by 1985 (DOI, FWS, per. comm., 1989). The population has increased over the past several years, and is presently estimated at 69,900. Probable factors responsible for the decline include excessive harvest of birds and their eggs on the breeding grounds, excessive harvest in migration and wintering areas, and declining availability of suitable winter habitat (i.e., only 4% of the original wetlands of California's Central Valley remain, and certain agricultural land uses reduce suitable habitat still further). Adverse weather conditions that delay nesting also can have a major effect, and an increasing level of disturbance on the delta and Alaska Peninsula has a similar long-term potential.

Breeding cacklers arrive on the Y-K Delta coastal fringe in early May. Nesting begins in late May in vegetated intertidal areas and wet tundra meadows. In August, most of the population migrate south along the coast to Ugashik Bay and Cinder River on north side of the Alaska Peninsula where they feed on intertidal meadows until October. Small numbers of cacklers also molt and stage on Nunivak Island during the fall. From the peninsula, most proceed in October on a direct flight to the Willamette Valley in Oregon and the Klamath Basin in northern California where they rest and feed until late November, at which time the majority proceed to the wintering area in the Central Valley of California. Greatest overwintering concentrations occur in the Sacramento Valley, the San Joaquin Valley, and the San Francisco Bay area. A small percentage winter in Oregon. For most of the population, the spring migration route in late April and early May includes stops in southeast Alaska, Copper/Bering River Deltas, Prince William Sound, and several areas in Upper Cook Inlet (Redoubt Bay, Trading Bay, and Susitna Flats) before proceeding overland to the Y-K Delta.

(4) Pacific Black Brant

From a high point of about 187,000 in the mid-1960's, the Pacific black brant population declined to about 109,000 by 1983 (DOI, FWS, per. comm., 1989). The population has increased over the past several years, and is presently estimated at 138,600. Probable factors responsible for the decline include excessive harvest of birds and their eggs on the breeding grounds, excessive harvest in migration and wintering areas, declining availability of suitable winter habitat, and elevated effects of predation on the reduced population. Adverse weather conditions that delay nesting also can have a major effect, and an increasing level of disturbance on the Y-K delta and in the vicinity of Teshekpuk Lake and Izembek Lagoon has a similar long-term potential.

Currently, probably less than 20 percent of the world black brant population nests in the vegetated intertidal zone of the Yukon Delta (King and Dau, 1981). Nesting densities, exceeding 1,500 nests per km^2, were recorded there in the 1970's. Substantial numbers also nest on the arctic slope between Wainwright and the Colville River, and some also nest on Wrangel Island off the Siberian coast and in arctic Canada. Brant nest in colonies in the extreme coastal fringe or tidal meadows along major estuaries, generally beginning about mid-May . From late June to August, brant from the arctic slope, as well as substantial numbers from the Y-K Delta and Wrangel Island (perhaps 20-25% of the population; King and Derksen, 1987), gather in the Teshekpuk Lake/Cape Halkett area to molt and feed prior to the first stage of the southward migration. Molting Canada, white-fronted, and snow geese also are present at this time. In August, following the molt, this segment of the population migrates along the northern and western coasts of Alaska to Izembek Lagoon on the Alaska Peninsula where they join migrants from the Y-K Delta that are feeding on the extensive eelgrass beds from September to November to accumulate fat reserves necessary for completing their migration. In late October or early November, they depart essentially en masse on a nonstop flight across the North Pacific to California and Mexico. The majority (over 90%) winter in lagoons of Baja California and mainland Mexico, but small numbers may be found along the West Coast from California to British Columbia. Prior to 1960, substantial numbers overwintered in coastal California, but these have declined precipitously as numbers have increased along the Mexican coast. Several thousand brant may overwinter in the Izembek Lagoon area. Spring migration is more gradual, and brant concentrate in numerous bays on the trip north. Brant arrive at

Izembek Lagoon for spring staging in late April and early May, remaining for about 3 weeks to accumulate fat reserves before moving on to the Y-K Delta and northern nesting areas.

(5) Other Geese

Tule geese, a subspecies of white-fronted, nests in Redoubt Bay on the west side of Cook Inlet. The population, probably numbering no more than a few thousand, winters in three small areas of inland central California.

Taverner's Canada geese, numbering approximately 100,000 individuals, breed throughout interior Alaska and onto the Yukon Delta. A majority of these gather in fall at Izembek Lagoon with brant and emperors. Flocks of Taverner's depart sporadically for the flight across the North Pacific to the Columbia River Basin. A substantial proportion of the migrants move on to the Klamath Basin and eventually the central valley of California. Northward migration follows an inland route through British Columbia and interior Alaska.

Vancouver Canada geese (population 40,000-50,000) breed in southeast Alaska, and, being largely nonmigratory, most overwinter within 150 miles of the nesting areas. Fewer than 20 percent migrate as far south as Washington.

Dusky Canada geese, with a population of 10,000-15,000 and declining, breed primarily on the Copper River Delta. Heavy predation pressure appears responsible for much of the declining trend (15-80% of nests destroyed since 1974; Campbell et al., 1987), and the population is heavily hunted on wintering areas. Habitat changes following the 1964 Alaska earthquake altered the delta's suitability for nesting (Alaska Dept. of Fish and Game, 1986), and may be responsible for much of the high rate of predation. A small proportion of fall migrants crossing the Gulf of Alaska stop in the Queen Charlotte Islands or Vancouver Island, but most continue to wintering areas in Oregon's Willamette Valley.

Lesser Canada geese, with a population of approximately 2,000, nest in the Cook Inlet area; most winter in the Willamette Valley of Oregon.

Lesser snow geese frequenting Alaska (population about 40,000 or fewer) breed on Wrangel Island off Siberia and on Howe Island off the Sagavanirktok River Delta near Prudhoe Bay. In mid-September, they are found on St. Lawrence Island and the Seward Peninsula; in late September and October, large numbers occupy the southern Yukon Delta and intertidal areas of Ugashik Bay on the Alaska Peninsula before heading south to the Central Valley of California in late October. In addition, several hundred thousand snow geese that nest in northwestern Canada migrate to the northeastern Alaska coastal plain prior to returning east for their fall migration through Canada (Johnson et al., 1987). On the northward migration in April and May, substantial numbers occupy staging areas on Cook Inlet wetlands.

Adverse weather conditions that delay nesting can produce a major negative effect in any of these species, and increasing levels of disturbance on breeding, staging and wintering grounds have a similar potential in the long term. Those species wintering in the Lower 48 States, especially California, increasingly find traditional areas of suitable habitat no longer available; for example, only 4 percent of the original wetlands of California's Central Valley remain, and certain agricultural land uses reduce suitable habitat still further.

b. Diving Ducks

Some eighteen species of diving ducks breed in Alaska; most common are the oldsquaw (approximate population occurring in Pacific/Alaska waters, 3.6 million), common eider (750,000), king eider (1.8 million), spectacled eider (250,000), Steller's eider (400,000), black scoter (490,000), surf scoter (116,000), white-winged scoter (400,000), greater scaup (340,000), harlequin duck (1 million), Barrow's goldeneye (120,000), common goldeneye (110,000), and red-breasted merganser (20,000). Of these, mainly the eiders, oldsquaw, and scaup nest prominently in coastal areas or on islands. At present, increasing disturbance resulting from human activities is a major factor influencing habitat suitability and availability. This may range from occasional human presence to vehicle use or conversion of habitat to residential, recreational or other uses. Displaced breeders may be forced to nest in marginally suitable habitat where competition, predation, and/or disease are elevated. Also, human activities near wetlands often result in decreasing water quality. Reproductive success of any of the breeding species is affected adversely by persistence of severe weather early in the nesting period.

Most species of diving ducks that nest in Alaska are prominent residents of Alaskan coastal areas in winter. Scaup and substantial proportions of scoter, goldeneye, and merganser populations move south along the west coast of Canada and, for several species (scaup, scoters, and mergansers), as far as California. Oldsquaw, eiders, and harlequin duck, together with substantial numbers of all three scoters, bufflehead, goldeneye and red-breasted merganser, primarily remain in Alaska. Eiders and oldsquaw, in particular, winter as far north as open water is available, typically in the St.Lawrence Island polynya, but on occasion in the vicinity of the Diomede Islands in Bering Strait or as far north as Point Hope in the Chukchi Sea. The St. Lawrence Island area provides an important winter retreat for an estimated 50,000 eiders and 500,000 oldsquaw from December to May (Fay, 1961). Likewise, polynyas associated with St. Matthew and Nunivak Islands, as well as openings in the seasonal pack ice of the southern Bering Sea, support substantial numbers of king and common eider, harlequin duck, and oldsquaw (McRoy et al., 1971). Wintering common, king, and Steller's eiders, as well as oldsquaw and harlequin ducks, also are abundant in the Aleutian Islands and along the Alaska Peninsula to Kodiak Island. The latter two species are abundant in winter through southeast Alaska.

Spring migration for diving ducks that overwinter in southern localities (e.g., goldeneye, bufflehead, and mergansers) occurs from late March to late May in Gulf of Alaska staging areas such as the Copper River Delta and bays and deltas of Cook Inlet. Eiders and oldsquaw are in migration at sea in late April and May, arriving on the Yukon Delta in mid-May, the Bering Strait in mid- to late May, and off the arctic slope from late May to mid-June. Nesting for eiders breeding on the arctic tundra, barrier islands, or river deltas begins in mid-June.

Beginning in mid-July, large concentrations of oldsquaw and eider occupy coastal inshore waters where they molt prior to the fall migration. Deltas of the major arctic slope rivers also are occupied by molting waterfowl. Likewise, in the Yukon Delta region and elsewhere along this coastline, nonbreeding eiders remain in nearshore waters throughout the summer and are joined by adult males soon after incubation begins. Nearshore waters of Bristol Bay and lagoons along the north side of the Alaska Peninsula are important areas for migrating ducks. For example, Arneson (1980) reported 85,000 Steller's eiders and 51,000 scoters along the peninsula in fall.

c. Waterfowl

Important waterfowl habitat is distributed among bays, lagoons, and estuaries on the Pacific Coast. Information on various waterfowl species which may be contacted by OCS activities may be obtained by consulting Cogswell (1977) and Page et al. (1977). Predominant waterfowl which may occur in areas potentially affected by OCS activities include dabbling ducks (wood duck, European and American widgeon, gadwall, northern shoveler, mallard, pintail and green-winged, blue-winged, and cinnamon teal) and the loons and grebes.

There are six species of these two families that are common winter visitors of nearshore waters and coastal estuaries in the Alaska/Pacific Regions. All loons and grebes prey primarily on fish by diving and underwater pursuit.

(1) Pacific Loon

Pacific loons (*Gavia pacifica*) are the most abundant and pelagic of the loons found off the Pacific Coast. The North American populations of this species breed on freshwater lakes along the Arctic Circle in Alaska and Canada and winter on salt water along the Pacific coast from southeast Alaska to southern Baja (Palmer, 1962; as cited in Briggs et al., 1983). Pacific loons are found in the Pacific Region throughout the year, but large numbers occur only during the fall migration (Briggs et al., 1983). Although no total populations estimates are known, the size of the Alaska population that migrate through the Pacific Region is thought to range into the hundreds of thousands. During migration, Pacific loons are commonly observed in large flocks near the coast during daylight hours.

During 3 years of survey, Briggs et al. (1983) found Pacific loons arriving in northern California waters in October, with the peak of fall migration in November. Peak numbers of fall migrants reach southern California in mid-December. Highest densities of Pacific loons were observed over continental shelf waters; most birds were found from 5 to 50 km offshore.

Briggs et al. (1983) observed that the northbound (spring) migration began in March, peaked in April, and tapered off in May. The actual turnover rate during migration is unknown. However, Briggs et al. (1987) estimate 75,000-290,000 birds pass through central and northern California, and 40,000 - 60,000 through southern California in spring. In fall only 5000 - 19,000 birds are estimated to pass through central and northern California, and about 5,000 through southern California.

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A small percentage of birds do not migrate south (or north) of California. Briggs et al. (1987) estimate that about 10,000 - 15,000 birds overwinter in California waters. They also estimate that only 1,000 - 5,000 birds spend spring and summer in California waters.

(2) Western Grebe

Western Grebes (*Aechmophorus occidentalis*) winter along coastal Pacific waters from southeast Alaska to western-central Mexico, and inland from central California and Nevada southward (Cogswell, 1977). Breeding occurs on lakes from southern British Columbia, northern Alberta, and Minnesota south to Colorado, and north and central-east California (Cogswell, 1977); small local breeding sites are known from farther east and south as far as central Mexico (Briggs et al., 1983). Total population estimates of this aquatic diving bird are unknown.

Briggs et al. (1983) observed the first migrants appearing in late September, spreading throughout their coastal range by December. Western grebes begin moving north and inland in March and are usually gone by the end of May. Peak populations along the California coast occurred from November through January, when 25,000 were estimated to be present north of Point Conception and some 27,000 birds south of the Point. (In fact, from October to May they are one of the predominant species within .5 km of the mainland.)

Western grebes occupy a narrow band of shelf water, usually dispersed within 3 km of the mainland coast. Sightings made by Briggs et al. (1983) suggested that grebes occupy the narrowest bands of coastline during moderate weather and may leave coastal waters entirely in stormy weather. Grebes are very uncommon offshore, even on nearshore islands.

d. Seabirds

Perhaps the most prominent and numerous avian group found in the Alaska and Pacific Regions are the pelagic (open ocean) seabirds. This group consists of birds such as shearwaters, petrels, murrelets, auklets, and gulls. These seabirds exhibit a wide array of body forms, life history patterns, and strategies for obtaining food, reproducing, and avoiding predation.

Most people are, at least, casually familiar with terrestrial birds and, as such, tend to base their understanding of seabirds upon this knowledge. Seabirds are, however, very different from terrestrial in a number of ways. Seabirds evolved in an environment free of many of the predators faced by terrestrial birds and an environment with a less predictable food source. These factors have led to the development of strategies such as: long life spans, late attainment of sexual maturity, and small clutch sizes (Sowls et al., 1980). All these factors are the exact opposite of most terrestrial species.

These aspects of the dynamics of seabird populations (especially their late breeding age and low clutch sizes) tend to make their populations particularly vulnerable to a catastrophic disturbance. Such a disturbance could impact several generations and take years to overcome.

Another characteristic of seabirds that makes them vulnerable is their colonial nesting behavior. During the breeding season, most are concentrated at only a few nesting colonies. Therefore, any disturbance at the colony has the potential to affect a large number of birds.

The Alaskan seabird population is unique in both size and species diversity. The population has been estimated at some 100 million birds of more than 75 different species from May to November. The majority of the birds (some 75 percent) remain south of the Arctic Circle. With the onset of winter in late November, the majority of birds (about 80 percent) migrate to warmer climates. Very few seabirds remain in the Chukchi and Bering Seas when these areas are ice covered from November to mid-April.

Compared to the numbers of seabirds in Alaska, the seabird population in the Pacific Region is modest at best. There are only about 1.7 million breeding seabirds in the Pacific Region.

The majority of the total seabird biomass found in the Pacific Region, however, consists of seasonal migrants. Migrating shearwaters and phalaropes number well into the tens of millions during April and May, and almost as many birds are found during the winter.

The affinity of seabirds towards oceanic upwellings has been known at least since Murphy (1936). The importance of upwellings is that they initiate plankton blooms which result in increased crustacean, fish, and squid production, thereby, providing an abundant food source for seabirds.

This discussion is based primarily on Haley (1984), Ashmole (1971), Bartonek and Nettleship (1979), and Briggs et al. (1987); also, emphasis is on only those aspects of the birds life history that relate to their migration.

(1) Shearwaters

These birds (of order Procellariiformes) are true marine birds in that they are largely independent of land for feeding or resting and come ashore only to reproduce. In the Alaskan/Pacific area, the sooty and pink-footed shearwaters (*Puffinus griseus and P. creatopus*) are by far the most common. These birds breed primarily on islands off southeastern Australia and Cape Horn, South America, from November to March. After breeding, they migrate throughout the North Pacific where they winter from April to October. Wintering populations in the North Pacific have been grossly estimated at 30 million birds each. During this time, shearwaters make up almost 90 percent of all seabirds seen in the open ocean.

In southern California, these birds tend to be found on the coolest waters: major upwelling centers stretching along the Santa Rosa-Cortes Ridge, south of Point Conception, shallow island shelves, and the western Santa Barbara Channel. North of Point Conception, they are found over the continental shelf.

These birds feed by pursuit plunging. That is, they pursue squid, crustaceans, and schooling fish by diving from the surface or plunging from the air.

(2) Phalaropes

Phalaropes are shorebirds adapted to swimming and taking prey (primarily crustaceans and fish eggs) from the ocean surface. The northern (or red-necked) phalarope (*Phalropus lobatus*) and the red phalarope (*P. fulicarius*) are extremely abundant in the Alaskan/Pacific Regions in April and May and again in August to October, sometimes numbering 3 to 4 million, as they pass through during their migration. These birds nest in Alaska and winter off coastal southern California to the Antarctic. During their migration, phalaropes tend to concentrate in flocks as large as a thousand near the coast in spring, over the Outer Continental Shelf and slope in the spring and fall, and seaward off the shelf in the winter. On these wintering areas, phalaropes spend most of their time on the open ocean, as opposed to wading like other shorebirds. They feed by swimming in tight circles to stir up prey and pick them from just beneath the surface.

(3) Alcids (Murres, Murrelets, and Puffins)

Most of the breeding seabirds (about 47 percent) in the Proposed Sale area belong to this family. Alcids have been called the northern ecological counterpart of penguins. Their most striking similarity with penguins is their ability to "fly" underwater in pursuit of prey by using their short, narrow wings as powerful paddles while their feet act as rudders. Some can dive up to 130 m (430 ft) in pursuit of fish, crustaceans, or mollusk. All the alcids in the Alaska/Pacific Regions generally feed in shallow waters close to shore, especially during the nesting season when they stay within a few miles of the colony. They also tend to be colonial feeders (except the murrelet), many aggregating into flocks of 10-30 at certain "hot spots." Except when incubating eggs or caring for hatchlings, birds spend very little time on land; rather, most of their time is spent on the open ocean loafing or diving for prey.

The breeding season for most alcids in the Regions is from March to July. Breeding age is usually attained at 2-3 years. Tufted puffins (*Fratercula cirrhata*), common murres (*Uria aalge*), and marbled mureletts (*Brachyrampus marmorantus*) all lay only one egg. After the breeding season (which usually has ended by August), many breeding alcids remain in the general vicinity of the breeding colony. Birds from the more northern latitudes typically migrate southward.

The common murre is probably the most colonial of the alcids. In the Pacific, they breed from the Bering Sea to central California. There are about 5 million murres in Alaska, 6,000 in British Columbia, 21,000 in Washington, 250,000 in Oregon, and some 360,000 in California.

The California subspecies is mostly sedentary, that is, they remain near the breeding colony throughout the year. Birds migrating south from British Columbia and Alaska augment resident populations from September through March with concentrations at Monterey Bay, Point Sur, Morro Bay, and the eastern Santa Barbara Channel.

Tufted puffins are found from Cape Lisburne (in NW Alaska) south to Hokkaido, Japan, and along the North American coast to the Farallon Islands offshore northern California.

The North American population numbers about 4 million most being in Alaska. These birds are only now becoming re-established in the contiguous United States after decades of population decline. Presently, only a few thousand are distributed along the coast of British Columbia, Washington, Oregon, and California.

These birds nest in large colonies and use excavated burrows in soil or rock crevices for nest sites. The breeding season is typically in May. After the breeding season, many northern breeders remain near the colony until the onset of winter and then migrate south, like most northern alcids. Puffins start appearing in peak numbers in northern and central California in March and April. In southern California, the largest numbers of birds are seen from January to May. After May, most birds return to their northern breeding colonies.

Marbled mureletts breed along the North American coast from the Aleutian Islands to central California. (In Asia, they are found from Siberia, south to Korea, Japan, and the Jurile Islands.) In North America these birds are more common on the north end of their breeding range. More than 50,000 breeding pairs occur in Alaska; Washington has 1,900-3,500 breeding pairs; Oregon has an estimated 2,400; and the California population estimate is less than 1,000 breeding pairs. They are currently under petition to be listed as a threatened species in Washington, Oregon, and California (53 FR 40479, October 17, 1988).

Only very recently has the breeding biology of marbeled mureletts become known. (It was not until 1975 that the first nest was found.) They do not nest in colonies. Nest have been found mostly in Alaska and mainly on steep slopes. From southeast Alaska south, only two nest have been found, those being in old-growth conifer trees. Nesting occurs from mid-April to late September. Little is known about the distribution of post-breeding birds, except that they likely remain near the breeding area throughout the year.

e. Shorebirds

Shorebird is a term typically applied to that group of birds that occupy the narrow strip of habitat on the coastline, bays, lagoons, and estuaries. In this discussion, it applies to birds of the plover, sandpiper, and avocet families (*Charardriidae*, *Scolopacidae*, and *Recurvirostridae*, respectively). Predominant shorebirds in the Alaska/Pacific Regions include plovers, sandpipers, turnstones, snipes, and stilts. The following discussion on shorebirds is based largely on Pitelka (1979) and Recher (1966).

Shorebirds are found in greatest numbers and diversity in the tidal flats (mudflats and sandflats) of sloughs, estuaries, and lagoons where they feed primarily by probing the substrate for invertebrates. Some shorebirds (e.g., stilts and yellowlegs), however, feed in the water column rather than the substrate. The coastal rocky intertidal zone and open sandy beach support fewer species (and numbers) of shorebirds. Most shorebirds are typically true migrants. In the North Pacific, shorebirds mostly migrate from northern breeding areas in Alaska to southern wintering areas (in some cases as far south as southern Chile).

There are four aspects of shorebird migration that are noteworthy. First, shorebirds generally "hold" at certain staging areas prior to taking the next migrational leap. Secondly, the spring migration is generally tighter (i.e., takes place in a shorter amount of time) than the fall migration. Third, there appears to be some site tenacity for wintering grounds as birds generally return to the same area year after year. Lastly, inter- and intra-specific competition on staging areas is reduced by staggering the times of migration. That is, shorebird migration is not a gradual increase and then decrease in the number of migrants. Rather, it is a secession of peak numbers within: groups of species, various age classes, and various sexes into and out of the staging area.

A variety of coastal bird populations are found occupying the sandy beaches, rocky shores, estuaries, and wetlands (marshes, sloughs, and bays) of the Alaska/Pacific Regions. Available habitat in some areas (especially California) for these species has been greatly reduced over the last several decades due to urban and recreational development projects. Large percentages of California's coastal wetlands have disappeared, resulting in the loss of valuable habitat to several coastal birds which are dependent on wetlands for their survival. Although wetlands provide important feeding and resting areas for hundreds of coastal dependent and migratory bird species, this loss of habitat has had the most severe impact on those species which are dependent on wetlands for nesting.

The prime breeding range of the western sandpiper (*Ereunetes mauri*) is the Y-K Delta and the Seaward Peninsula. Following the breeding season (May - August), birds migrate south to winter along the Pacific

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Coast from California to Peru. The number of migrating sandpipers has been estimated at approximately 5 to 6.5 million.

Both spring and fall migrations takes place in a series of "hops" to staging areas, where birds spend time feeding heavily to store up fat for the sustained nonstop flight to the next staging area. Some important staging areas along the migration route include: the Cooper/Bering River Deltas (near Valdez, Alaska); Vancouver Island, British Columbia; Puget Sound, Washington; Humboldt Bay, California; San Francisco Bay, California; and San Quintine Bay, Baja California.

D. Fish Resources

1. Pacific Salmon

Five species of anadromous Pacific salmon spawn in streams rivers of the Alaska and Pacific Regions and migrate either through planning areas within the or between the regions. These five species include: chinook, coho, chum, pink, and sockeye salmon. The distribution and life history characteristics of these species are well described by Hart (1973) and other sources. Adults of each species spawn in freshwater streams, rivers, and/or lakes where their eggs are deposited in gravel nests and remain until hatching. Newly-hatched young undergo early development in freshwater for a variable period of time, but eventually the young salmon migrate downstream, undergo a physiological process called smoltification, and then enter the ocean as juveniles. Juvenile salmon spend from one to several years in the ocean environment where they may undertake a lengthy migration, feed and mature into adults, and then migrate back to their stream or river of origin to spawn.

Chinook salmon stocks spawn in rivers and streams extending from the Sacramento-San Joaquin River system in central California to Point Hope, Alaska (Frey, 1971). Adult chinook enter streams or rivers in so-called spawning runs throughout the year at least somewhere in their range (Hart, 1973). Some rivers have only a single run, whereas others such as the Columbia or Sacramento River in the Pacific Region may have several separate runs (MBC, 1987). Most chinook runs in the Pacific Region occur in the fall (August through November), although from Washington south there is also a spring run (March through June) in many rivers (MBC, 1987). The Sacramento River also supports a unique winter (November to February) spawning run of chinook salmon. Coho salmon stacks spawn over a similar geographic range that extends from Monterey Bay in central California to Nome, Alaska (MBC, 1987). Important spawning streams or rivers occur in central California, northern California, and Washington/Oregon area for both Chinook salmon (Allen and Hasler, 1986; Frey, 1971; MBC, 1987; and Pacific Fishery Management Council [PFMC], 1984) and Coho salmon (Hasler, 1987; Lanfle et al., 1986).

Chum and pink salmon typically spawn in streams from northern California through the Bering Sea in Alaska (Hart, 1973). Sockeye salmon, however, generally spawn over a more restricted geographic range that typically extends from the Columbia River northward through Bristol Bay in Alaska (Hart, 1973). Within the Pacific Region, therefore, spawning and production of these species are largely restricted to streams located in Washington/Oregon area (Hart, 1973; Pauley et al., 1988). Pink salmon typically begin their freshwater spawning run in September or October, with chum salmon beginning their run in the late fall, winter, or spring. Generally, chum salmon are the last of the five species of salmon to enter freshwater on their spawning run. Sockeye generally begin their spawning run during the summer.

According to the PFMC (1982 and 1984) the long-term trends for many salmon stocks in California, Oregon, and Washington have been towards lower levels of abundance when compared with the historically high levels of stock abundance. In 1981, the PFMC considered most chinook and coho stocks in the Pacific Region to be in a depressed condition, with a declining trend in abundance. More recent information from the PFMC on the status of major chinook, coho, and pink salmon stocks originating in California, Oregon, and Washington indicates that at least some stocks have increased in abundance over the past few years as a result, in part, of more stringent management by the PFMC. The major factors considered responsible for declining stock abundance, and the continuing difficulty in restoration, have been increased fishing pressure and environmental or habitat degradation (PFMC, 1984). Hatchery production which is used to heavily supplement weak natural stocks may reduce the genetic complexity and resistance of natural stocks, as well as contribute to the generation of continued fishing pressure. Fishing pressure on these salmon stocks occurs primarily within the Pacific Region, but may also occur as fish pass through Canadian and Alaskan waters, or even on the high seas by foreign nations, during the course of their oceanic migration. Habitat degradation and/or loss affecting many salmon stocks has occurred as a result of water diversions for agriculture and development, dam construction and sedimentation from forestry, and other construction activities. The PFMC (1984), for example, estimated in 1981 that about 60 percent of the historically suitable spawning habitat along the Columbia River had been destroyed as a result of these factors.

Juvenile salmon of all species spend from one to several years in the ocean environment where they may undertake a lengthy migration, feed and mature into adults, and then migrate back to their stream or river of origin to spawn. In the Pacific Region, most chinook salmon originating from the Sacramento/San Joaquin River system in the central California area and coastal streams in the northern California area move northward along the coast, at least to Vancouver Island (MBC, 1987; PFMC, 1982). The extent of the northward movement fluctuates considerably depending upon ocean conditions, food availability and the individual stock. Some fish from this system apparently also move southward into the Monterey Bay area, as well as further south (Allen and Hasler, 1986). Some evidence suggests that fall-run chinook remain relatively close to their natal streams during their ocean residence, while spring-run chinook move further northward (Allen and Hasler, 1986). Most fish originating from coastal streams and rivers in the Washington/Oregon also move northward to British Columbia, and southeast Alaska, and may eventually be caught as adults offshore British Columbia, Washington, Oregon, and northern California (PFMC, 1982). Chinook produced from streams in the Puget Sound (i.e., the Washington/Oregon) are thought to move into waters offshore British Columbia, but not much further northward. Similarly, Columbia River chinook, depending upon the run, move northward to British columbia or southeast Alaska while some fish also eventually occur off Oregon and northern California. Chinook salmon remain in the ocean for 1-5 years, although most return to their natal streams or rivers to spawn after 3-4 years (Allen and Hasler, 1986). The PFMC (1982) illustrates generalized oceanic migratory patterns for chinook stocks originating from streams or rivers in California, Oregon, and Washington.

The offshore migratory patterns of coho salmon originating from streams in California, Oregon, and Washington are also illustrated in Hassler (1987) and Laufle et al. (1986). Most coho salmon produced from streams in California appear to remain closer to their home river than do chinook, and to migrate only as far northward as Oregon and Washington. Coho originating from streams in Oregon appear to move at least as far north as British Columbia. Coho originating from Washington and British Columbia streams exhibit two types of migratory behavior; some migrate long oceanic distances, and others remain closer to their home stream. Coho that undergo long oceanic migrations apparently concentrate in the Gulf of Alaska in the summer and then eventually disperse coastward. Adult coho generally spend two growing seasons at sea before returning to their streams of origin for spawning.

The offshore oceanic migration and distribution of both chum and pink salmon extend into waters off British Columbia and southeast Alaska, as well as into the Gulf of Alaska (Hart, 1973). Chum salmon may remain in the ocean for 2-7 years; however, most of those produced in Oregon and Washington return to spawn after 3-4 years. In contrast, pink salmon have a unique 2-year life cycle with genetically isolated even and odd year runs, resulting in an oceanic residence of less than 2 years. Sockeye salmon juveniles and adults produced from the Washington/Oregon area in the Pacific Region migrate northward and offshore into waters off British Columbia, southeast Alaska, and possibly the Gulf of Alaska and along the Aleutian Chain (Hart, 1973). Most sockeye salmon remain in the ocean for 2 years before migrating back to their natal streams to spawn.

2. Walleye Pollock

The range for walleye pollock extends continuously around the continental shelf areas of the northern Pacific Ocean and Bering Sea. In the Northeast Pacific, walleye pollock extend from St. Lawrence Island (south of the Bering Strait) throughout the Bering Sea, through the Gulf of Alaska, and along the northeastern Pacific coast to central California (Hart, 1973; Smith, 1981).

Pollock are the most abundant demersal fish on the continental shelf of the Bering Sea. Their populations declined in the early 1970's because of overharvesting by foreign fisheries, but slowly increased to a standing stock biomass of approximately 7.5 million tons by 1979 (Thorsteinson, 1984). The Bering Sea stock is currently stable, although smaller than prior to its decline (Sale 92 FEIS, DOI, MMS, 1985). In the Gulf of Alaska, a large, dense group of prespawning and spawning pollock was discovered in the Shelikof Strait area in 1980 (Sale 88 FEIS, DOI, MMS, 1984). Since that date, pollock have been fished in the Shelikof Strait, and the total biomass of pollock has declined substantially. The reasons for this decline are not known, but overfishing and poor recruitment are both possibilities. In the past, it was believed that pollock from the entire central and western Gulf of Alaska migrated to the Shelikof Strait in the spring (Draft Resource Assessment Document for the 1989 Gulf of Alaska Groundfish Fishery, 1988).

If so, then the population of pollock in the Gulf of Alaska could be at a very low level. It is also possible that the premise of extensive concentration in the Shelikof Strait from a much broader area is not valid.

At least in the eastern Bering Sea, pollock undergo seasonal and diurnal migrations associated with spawning and feeding. Their distribution appears to be related to water temperature (Morris, 1981). Overwintering occurs along the outer shelf and upper slope at depths of 150 to 300 meters, where bottom temperatures are warmer (Morris, 1981). As water temperatures rise in the spring, pollock move to more shallow waters (90 m to 140 m), where they spawn. From March through July, spawning occurs along the outer shelf, with major concentrations between the Pribilof Islands and Unimak Island (Lewbel, 1983). Following spawning along the southeastern Outer Continental Shelf, the northwest drift apparently carries larvae and metamorphosing juveniles to the vicinity of the Pribilofs (Smith, 1981). By 1 year of age, pollock are distributed broadly over the entire central and Outer Continental Shelf, completely overlapping the adult range, but also extending inshore beyond the adult range (Smith, 1981). By 2 years of age, pollock are more restricted to deep water (Smith, 1981). As they mature at ages 3 to 4 year, juveniles join the adult demersal population on the Outer Continental Shelf.

3. Steelhead Trout

Steelhead trout (*Oncorhynchus mykiss)* are sea-run (i.e., anadromous) rainbow trout that primarily use coastal streams and rivers from Central California to the Bering Sea and Bristol Bay in Alaska for spawning. Important spawning streams occur in northern California, Oregon, and Washington (Barnhart, 1986; Pauley et al., 1986). Two general races, or runs of steelhead exist: winter-run and summer-run. Winter-run steelhead migrate to and enter their natal streams in the late fall and winter (November through April), whereas summer-run steelhead migrate upstream during the spring and summer (May through October). Steelhead may enter some large rivers, such as the Klamath, Sacramento and Columbia, throughout most of the year. California stocks apparently consist almost entirely of winter-run steelhead because of unsuitable summer stream conditions; however, Oregon, Washington, and southern British Columbia stocks are comprised of both summer and winter runs. Winter-run steelhead enter their home stream and normally spawn within the next few months. In contrast, summer-run fish enter their home stream in a non-reproductive condition, and do not mature and spawn until the following spring. Steelhead spawning generally occurs from February to late June, depending upon the type and location of the run, and is similar to salmon spawning. Unlike salmon, however, steelhead do not die following spawning, and may reproduce several times.

The abundance of steelhead in California has declined dramatically since the 1950's due to increased sportfishing pressure and damage to freshwater and estuarine fish habitats as a result of dam construction, water diversion, other types of construction, and generally improper land management practices (Barnhart, 1986). In California, attempts are underway to maintain existing natural stocks of steelhead and their spawning and rearing habitats, to restore or enhance presently degraded habitats, and to supplement natural production with hatchery-produced steelhead (California Department of Fish and Game, 1975, as cited in Barnhart, 1986). In some rivers, steelhead production and fisheries would be nonexistent without hatchery produced stocks. A similar situation exists in Oregon and Washington where steelhead abundance has declined from excessive sportfishing pressure and habitat loss and/or degradation (Pauley et al., 1986). In particular, the presence of dams and reservoirs, which cause loss of natural habitat and increased mortality of outmigrating smolts, has contributed greatly to the serious reduction of steelhead produced from Columbia River stocks (Pauley et al., 1986). Other factors contributing to the decline of steelhead include poor logging, road building and irrigation practices, and overgrazing by livestock. As in California, natural steelhead runs are heavily supplemented by hatchery stocking in Oregon and Washington. In the case of the Columbia River, for example, seventeen hatcheries plant steelhead smolts to supplement the remaining natural production (Ayerst, 1977).

In the Pacific Region most steelhead smolts enter the ocean between March and April. Juvenile and adult steelhead normally reside in the ocean for 1-4 years (usually 1-2 years for fish originating from California, and 2-3 years for fish from Oregon and Washington). In general, the length of the marine residence increases from south to north. Steelhead originating in Washington and Oregon spend at least a portion of their ocean residency in the Alaskan gyre system, although it is less clear whether fish from California move as far north. Tag-recapture data presented in Pauley et al. (1986) show that steelhead originating from streams in the Pacific Region may migrate as far north as southeast Alaska and the Gulf of Alaska, as well as along the Aleutian Chain before returning to their natal streams to spawn

4. Pacific Whiting

Pacific whiting (*Merluccius productus*) range from Baja California to the Gulf of Alaska; however, adult whiting are uncommon north of Hecate Strait, British Columbia, and are most abundant between the Columbia River in the OWPA and Montery Bay, California, in the CCPA. At least three subpopulations of whitings exist, with the major subpopulation centered off California, Oregon, and Washington. Adult Pacific whiting are found up to 400 km from shore off southern California, 300 km from shore off central California, and over the shelf and slope from there northward. Although juvenile and adult whiting may be found near the ocean surface, they are most abundant at depths in excess of 90-100 m. However, they are often near bottom associated with the continental shelf and slope (MBC 1987). Spawning of Pacific whiting occurs from Baja California to Cape Mendocino in northern California; in Puget Sound, Washington; and further north in the Straits of Georgia offshore British Columbia (MBC, 1987). Spawning schools typically occur at depths of 130-500 m, with spawning taking place from January to May. The eggs and larvae of whiting are found primarily at depths greater than 50 m (MBC, 1987). Peak spawning occurs in January and February, and possibly into March.

According to MBC (1987), fish-scale deposits in the southern California Bight suggest that the Pacific whiting subpopulation off California, Oregon, and Washington has undergone considerable natural fluctuations in abundance over the past 200 years. In the early 1900's, for example, the whiting population was evidently larger than at present based on this fish scale data. The Pacific whiting is a long-lived species, with several year classes contributing to the adult population and the commercial fishery at any given time. However, year class strength of whiting is highly variable and has been directly correlated to the existence of favorable environmental conditions at the time of spawning and early larval development (PFMC, 1987). For example, research fishing surveys conducted by the California Department of Game over the past 20 years indicate that strong year classes of whiting were produced in 1967, 1970, 1973, 1977, 1980, 1984, and 1986. In contrast, the same data suggest that year class failures occurred in 1981 and 1983. Historical catch data suggest that these dominant year classes support the commercial fishery for whiting. Analysis of fishery catch data from 1985-86 and the 1986 research fishing survey data from the California Department of Fish and Game suggest that the whiting population and fishery are presently dominated by young fish from the 1984 and 1986 year classes, and that the 1984 year class was extremely large (i.e., nearly 60 percent of population abundance and 37 percent of biomass estimates) (PFMC, 1987). These data suggest that over the next several years, the subpopulation of whiting centered off California, Oregon, and Washington will be at a high level of abundance. Future fluctuations in the abundance of this whiting subpopulation will most likely be related to the presence or absence of favorable environmental conditions at the time of spawning and early larval development, the frequency of strong year classes that tend to dominate the subpopulation, and the intensity of domestic and foreign commercial fishing pressure on the stock.

The northern spawning subpopulations of whiting in the Puget Sound and the Straits of Georgia are relatively sedentary and undertake only limited coastwide movements during the year (MBC, 1987). In contrast, the subpopulation of whiting centered offshore California, Oregon, and Washington undertake an extensive annual migration from spawning areas in the south to feeding areas in the north. Adults form spawning aggregations in the winter (January through March), primarily in the Southern California Planning Area (SCPA) and northern Baja California. Following spawning, whiting begin migrating northward in April towards coastal feeding areas that occur as far north as Vancouver Island off British Columbia. In May and June, whiting concentrate over the continental slope; by late June and July, they move inshore to depths of 100 m or less. Important coastal feeding areas for the aggregation of juvenile and adult whiting occur off central California, northern California, Oregon, and Washington. In July and August, whiting move offshore again and begin to migrate southward. The timing of this movement appears to linked with the seasonal development of the Davidson current off California, Oregon, and Washington (MBC, 1987). The southward migration takes place primarily in the fall, with spawning aggregations beginning to form in December offshore southern California.

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CHAPTER IV

ENVIRONMENTAL CONSEQUENCES

IV. ENVIRONMENTAL CONSEQUENCES

A. Introduction

This section is a discussion of the basic assumptions used in the cumulative impact analysis, the potential generic impacts that can result from OCS activities, and the potential cumulative impacts to migratory species whose migration routes traverse more than one planning area in the Alaska and Pacific Regions.

The SEIS tiers directly from the FEIS, and, therefore, incorporates by reference all materials contained in the FEIS Chapter IV, ENVIRONMENTAL CONSEQUENCES (pages IV.A.-1 to IV.B.22.-24). In some instances, the assumptions from the FEIS were modified to comply with the court's remand to "consider the effect of simultaneous inter-regional development on migratory species," and to reflect the alternative selected by the Secretary of the Interior as well as the current status of the 5-Year Leasing Program, Mid-1987 to Mid-1992.

The previous assumptions (FEIS Proposed 5-Year Program, Sections IV.A.1 through IV.A.4.b, pages IV.A.-1 to IV.A.-47) have been summarized below. These assumptions include estimates of the conditional oil and gas resources on the OCS and hypothetical scenarios of exploration, development and production activities. Assumptions concerning the likelihood of oil spill occurrences (based on historical spill rates and the conditional resource estimates) from OCS exploration, development, production and transportation activities were also made.

Discussions of the potential generic impacts of OCS-related oil and gas activities presented in the FEIS Proposed 5-Year Program Sections IV.A.4.c. through IV.A.10 (pages IV.A.-48 to IV.A.-117) have also been summarized. These summaries focus on those potential generic impacts which are relevant to the cumulative impact analysis of the migratory species. These discussions are not projections of expected impacts. Rather they are descriptions of the kinds of effects to which the migratory species are susceptible.

Information on projects considered in the cumulative impact assessment previously presented in the beginning of Environmental Consequences By Planning Area (Section IV.B.) for each planning area was restructured and is presented by Region. This describes the existing activities and reasonably foreseeable projects and proposals along the migration routes of the migratory species within the Alaska and Pacific Regions. These projects have been updated to reflect any changes in their current status.

The analysis of the cumulative impacts on migratory species within the FEIS Proposed 5-Year Program (Sections IV.B.7 through IV.B.21) has also been restructured. The cumulative impact analysis is presented in a single coherent section rather than fragmented by planning area.

The cumulative impact analysis in the SEIS assumes the implementation of all mitigating measures required by statute and/or regulation. As part of the 1987 Program, stipulations were highlighted which provide levels of protection similar to those included in Sales No. 73 and No. 80 for California are assumed. However, it is still assumed that the current process for development of lease stipulations will continue. During the consultation and analysis process that precedes each OCS lease sale, the need for additional mitigating measures will be identified, and lease stipulations which provide the necessary mitigation of potential adverse impacts will be developed and adopted for each lease sale, as appropriate.

B. Basic Assumptions and Significant Impact Producing Agents

1. Resource Estimates

As part of the initial steps in the preparation of the 5-Year Leasing Schedule, the potential oil and gas resources within each planning area were assessed. Using all relevant available geologic and geophysical data and the PRESTO Model, a regional assessment of the planning areas was completed. Estimates of the conditional undiscovered, economically recoverable resources and their associated marginal probabilities were derived for each planning area. The major elements constituting PRESTO and the method used in developing the probabilistic oil and gas resource estimates for the planning areas are described in OCS Report MMS 85-0012.

The conditional resource estimates for the FEIS are quantities of oil and gas resources that may be found and developed, given the condition that economically recoverable accumulations of hydrocarbons are present in the planning areas. The marginal probabilities which correspond to these resource estimates represent the chance or risk that economically recoverable hydrocarbons exist in the planning areas.

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Since the SEIS tiers directly from the FEIS, and in order to maintain consistency in the analysis between the two documents, the same conditional mean resource estimates (see Table IV.B.1-1 in the SEIS and Table IV.A.1-2 in the FEIS) for the cumulative case scenario are used. The conditional resource estimates for the cumulative case include estimates of total leased and unleased resources, and the total developed and undeveloped reserves in the planning areas. A detailed discussion of the resource estimates associated with the cumulative case scenario is contained in Section II.B.1.d of the SEIS.

2. Exploration and Development Assumptions

Table II.B.1-1 represents the level of offshore activity which may result from the exploration, the delineation of possible hydrocarbon bearing formations, and the establishment of production platforms. The estimates of infrastructure associated with these conditional resources were developed for evaluating the potential levels of impacts. The level of offshore activity as a result of the cumulative case scenario is detailed in Section II.B.1.e of the SEIS.

3. Projected Transportation and Markets

a. Introduction

This section summarizes the basic assumption made in the FEIS Section IV.A.3 (pages IV.A.-19 to IV.A.-25), concerning how oil and gas production will be transported to shore and whether production will be transported by tanker or pipeline to markets inside or outside of the planning areas. The present analysis is limited to examining issues related to the transport of product among domestic market areas. Table IV.B.4 [illegible] presents the specific transportation mode scenarios used in the cumulative analysis. For consistency with the FEIS, the same transportation modes and assumptions were made. The allocation of the percentage of pipelines versus tankering in a planning area is based on the assumptions presented in this section and existing transportation networks.

In analyzing the availability of transportation networks to deliver oil and gas to demand areas, both current and proposed networks were reviewed for all OCS planning areas.

As a result of this analysis, the decision whether to use pipelines, barges, or tankers to transport OCS oil and gas to shore is dependent on a number of factors, including technological constraints, environmental preferences, and economic considerations. The exact mode of transport cannot be determined until the amount of recoverable reserves is known and judgments are made as to what is environmentally preferable and technically and economically feasible.

Based on previous analyses and completed projects, oil companies generally prefer pipelines for transporting oil and gas to processing facilities when economics and other consideration justify their construction. Where pipelines cannot be justified, tankers or barges are necessary. In California, although pipelines have almost always been used, in some instances tankers are preferred by the oil industry. Tankers, in some cases, allow greater flexibility in terms of getting oil to refineries and market centers.

b. Transporting Oil and Gas Resources to Shore

Pipelines are generally used to bring oil and gas to shore in the Southern California Planning Area. However, tankers are employed in Southern California in a variety of situations to transport oil to refineries. The expansion of the offshore oil and gas pipeline systems in Southern California is expect to continue as a result of several large production projects currently being considered. Support facilities within Southern California are being consolidated to minimize pipeline landfalls. Therefore, the percentage of pipelines use versus tankers is higher. The percentage of oil production transported by tanker in Southern California reflects production prior to pipeline completions and the possible production from fields which cannot use pipelines for economic, physical (water depth), or environmental reasons.

In areas where there is currently no production, alternatives to a pipeline transportation system may be required. It was assumed, based on current geologic information, that oil resources in the Washington and Oregon, Northern California, and Central California Planning Areas would be transported by tanker to shore.

Since there is no oil and gas production on the OCS within the Alaska Region, the transportation systems are still speculative. However, for analysis purposes a separate transportation network was identified for each of the three Alaskan subregions. For the Beaufort Sea; Chukchi Sea; and Hope Basin Planning Areas, oil is expected to be transported through subsea and overland pipelines to the Trans-Alaskan

Table IV.B.1-1 Conditional Oil and Gas Resources, Reserves, and Infrastructure for the FEIS and SEIS Cumulative Case

					NO. OF		
PLANNING AREA	OIL (MMBBL)	GAS (BCF)	Million BOE	MPHC*	EXPL.& DEL. WELLS	DEV.& PROD. WELLS	PLATFORMS
Beaufort Sea	1280	--	1280	0.70	38	126	3
Chukchi Sea	2680	--	2680	0.20	85	263	7
Hope	170	1810	492	0.02	13	49	1
Norton	640	2940	1163	0.15	45	112	4
Navarin	4800	5840	5839	0.27	179	569	14
St. George	1690	15760	4494	0.22	147	444	12
N. Aleutian	360	2620	826	0.20	26	80	2
Shumagin	50	1420	303	0.03	11	30	1
Kodiak	150	2920	670	0.05	24	66	2
Cook Inlet	210	350	272	0.03	11	25	1
Gulf of Alaska	540	8340	2024	0.08	63	200	5
Washington/Oregon	180	3260	760	0.20	33	90	3
N. California	420	1860	751	0.60	33	88	3
C. California	300	560	400	0.65	21	46	2
S. California**	2613	4087	3340	1.00	524	2145	48

* MP_{HC} denotes marginal probability of commercial hydrocarbons.

** Includes developed and undeveloped reserves. The infrastructure for the Southern California Planning Area includes existing, proposed and hypothetical platforms and development and production wells.

Estimates of levels of exploration and development expressed in this table are based solely on the conditional resource level of the planning areas and are therefore, themselves conditional estimates.

MMBBL - Millions of Barrels
BCF - Billion Cubic Feet
BOE - Barrels of Oil Equivalent

Pipeline System (TAPS), where it would be routed to the Valdez tanker terminal (See SEIS, Section IV.C). Anticipated OCS oil production is not likely to exceed TAPS capacity and is expected to replace production from the Alaskan North Slope (ANS) which is estimated to decline in the late 1990's.

Consideration was given to ice-breaking tankers as a viable option to pipelines in many of the planning areas in Alaska, including the western portion of the Chukchi Sea and Hope Basin. Overall, tanker transportation may be an economically viable option selected by industry in Alaska.

In the second subregion, oil transportation for Alaska encompasses possible production within the St. George Basin, Norton Sound, Navarin Basin, and the North Aleutian Basin Planning Areas. Transportation projections for these areas feature a series of gathering and truck lines feeding into a central offshore or onshore terminal. Ice-breaking shuttle tankers would be used to move the oil to an ice-free deepwater port on the South Alaskan peninsula for shipment. As an alternative, the potential OCS production from the North Aleutian Basin could be piped directly to the terminal. Another alternative being considered by industry is the use of ice-breaking tankers to transport the product directly to market, thus minimizing the problems associated with unloading and reloading. The transportation of oil in the Bering Sea, however, would require the construction of new tanker facilities.

In the third subregion, oil production from the Shumagin Basin; Kodiak; Cook Inlet; and Gulf of Alaska Planning Areas, would be moved through subsea pipelines to storage facilities prior to being transported by tankers to market. Some new tanker facilities would likely be required.

There is currently no system available to transport natural gas from the Prudhoe Bay area to the contiguous United States. The Alaskan Natural Gas Transportation System (ANGTS) has been proposed to carry North Slope and Canadian natural gas to the lower 48 States. A portion of the pipeline is currently completed and is delivering gas from north of Calgary, Alberta, Canada, to Iowa and Oregon. However, the Alaskan and northern Canadian section of the pipeline remain unbuilt. Another pipeline, the Trans-Alaskan Gas System (TAGS), has been proposed and partially approved to transport the North Slope gas to Valdez, Alaska, for processing and transportation. In the absence of a gas pipeline, other gas transportation systems are being considered including liquefaction of natural gas (LNG) (See SEIS, Section IV.C.).

c. Transportation to Markets

Section IV.A.3.c. of the FEIS provides a detailed discussion on the Petroleum Administration for Defense District (PAD) V (Alaska, Hawaii, Washington, Oregon, California, Arizona, and Nevada) refinery capacity, assumptions, and calculations associated with the allocation of the oil from the Alaska and Pacific Regions.

The current capacity of existing transportation networks does not pose a major constraint to further subarctic offshore production. Modification to the network will be made when economically viable hydrocarbons are discovered. The availability of current transportation networks will facilitate the development of offshore resources. Restrictions in offshore development will be the environmental and economic costs associated with establishing and operating the transportation system. Transportation costs and availability are carefully considered when evaluating the economic feasibility of every hydrocarbon discovery. Resource development will not occur unless the hydrocarbons can be economically transported to regional and national markets.

Specific assumptions are made to allocate OCS oil production between West Coast and Gulf Coast refineries. These assumptions were based on a forecast of the PAD refining capacity. Both onshore and offshore production from California, Oregon, and Washington are allocated to PAD V refineries.

Alaskan oil is then allocated to the remaining PAD V refinery; capacity. Alaskan production not refined in PAD V is expected to be delivered to the Gulf Coast area for refining. Part of this excess is expected to be transported by pipeline. There are presently three proposed pipelines in various stages of the permitting process (See SEIS, Section IV.C.): the All American Pipeline, the Pacific-Texas Pipeline, and the expansion of the existing Four Corners Pipeline. For purposes of this analysis, it is assumed that these pipelines will be operational by 1995 for the transportation of PAD V oil.

There has been some concern expressed that the low-gravity, high sulfur oil found offshore California and the low-gravity crude from the Alaska North Slope could not be refined in most California refineries. Some California refineries are currently being modified to handle the oil from these areas.

4. Oil Spills

a. Oil Spill Analysis

The same assumptions concerning oil spills based on historical spill rates and the conditional resource estimates in the FEIS are used for the SEIS. The oil spill model data for the cumulative case are summarized and presented in Table IV.B.4-1. Since the publication of the FEIS, OCS platform, OCS pipeline and worldwide tanker oil spill occurrence rates have been updated (Anderson and LaBelle (1988)). The OCS platform and pipeline rates are significantly reduced from those of Stewart (1975, 1976) and Lanfear and Amstutz (1983) while worldwide tanker rates have not changed since Lanfear and Amstutz (1983). However, it was determined for this analysis that to maintain consistency between the SEIS and the FEIS the same spill rates for platforms and pipelines would be used.

Since the publication of the FEIS, the *Exxon Valdez* struck Bligh Reef in the Prince William Sound on March 24, 1989 releasing over 240,000 barrels of crude oil into the Sound. The oil slick has spread over 3,000 square miles and contacted 350 miles of shoreline. As of May 2, 1989, 191 miles were lightly oiled, 85 miles moderately oiled and 88 miles heavily oiled. Exxon reports that 42,000 bbls of oil have been recovered from the water. Experts are currently assessing the short and long term environmental and economic implications of the incident.

The original assumptions for the cumulative scenario included the volume of crude oil transported by tankers from Valdez. This volume (see IV.C.9.c.) was taken into consideration during the generation of the data for the oil spill table (Table IV.B.4-1). The estimated mean number of spills attributed to crude oil transportation from TAPS is 7 spills with a probability of greater than 99 percent that one or more spills would occur. Therefore, the analysis in the SEIS, takes into consideration the *Exxon Valdez* spill and potential future spills as a result of the transportation of oil originating from TAPS.

Additional assumptions were made to take into consideration the court's remand to analyze simultaneous development. The analysts assumed that two large (greater than 1,000) oil spills would occur in a given year as a result of OCS activities. Each spill would be in a different planning area. The analyst selected two planning areas for the location of these oil spills where the estimated mean number of spills for the 5-year program was greater than one, and where critical activities (life history) or areas for the migratory species existed.

Again, for the purpose of analysis it was assumed that the number of oil spills (see Table IV.B.4-2) in each planning area would occur within uniform frequency within that planning area over the 35 to 40 year life of the cumulative scenario.

Oil spills are considered one of the single greatest potential impacting agents to the environment from offshore oil and gas activities. As a result, MMS has developed the Oil Spill Risk Analysis Model (OSRAM) (LaBelle, 1986; LaBelle, et al., 1983; Smith, et al., 1982; Lanfear, et al., 1979) as a tool to aid in the overall understanding of the potential risk of oil spills to the environment from specific offshore oil and gas lease sales. A more detailed description of the OSRAM is contained in the reports above, as well as in the FEIS, Section IV.A.4 (pages IV.A.-25 to IV.A.-41).

The oil-spill modeling approach for the FEIS was to use the estimated number of oil spill occurrences (greater than or equal to 1,000 barrels (bbl)) and the estimated probability of one or more spills (greater than or equal to 1,000 bbls) occurring.

The model used in this analysis categorizes spills into volume classes; however, only oil spills greater than or equal to 1,000 bbls are considered. Most spill are in the range of 1-1000 bbls (with 99 percent of the spills less than or equal to 10 bbls), are usually the result of transferring or lightering operations.

Another important assumption is that the model incorporates the historical oil spill accident rates and assumes that these rates can be used to estimate future spills. The accident data are separated into three modes: production (platforms), pipelines, and tankers. The historical oil-spill rates from U.S. OCS activities (Gulf of Mexico and Southern California) are used to estimate spills from production and pipelines, and the worldwide tankering spill rate is used to estimate spills from tanker transportation. The model assumes that half of the spills from tankers will occur in the study area if the tanker route extends beyond the study area.

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Table IV.B.4-1
The Cumulative Case
Estimated Mean Number of Oil Spills Greater than 1,000 Barrels and Probability of One or More Spills (1)

	Conditional Oil Resources		Transport.	Estimated Spills From OCS Production in Planning Area					Estimated Tanker Spills From						Total Spills Estimated from All Sources	
							Total		Proposal OCS Transport**		Other Domestic		Imports			
Planning Areas	MMBBL	MP_{HC}*	Mode (2)	Plat. EM#	Pipe. EM#	Tank. EM#	EM#	Prob.	EM#	Prob.	EM#	Prob.	EM#	Prob.	EM#	Prob.
Washington/Oregon	180	0.20	T	0.18	0.00	0.23	0.41	0.34	0.09	0.09	0.72	0.51	1.93	0.85	3.16	0.96 *
Northern Calif.	420	0.60	T	0.42	0.00	0.27	0.69	0.50	0.00	----	0.00	----	0.00	----	0.69	0.50
Central Calif.	300	0.65	T	0.30	0.00	0.39	0.69	0.50	0.36	0.30	1.51	0.78	1.42	0.76	3.98	0.98 *
Southern Calif.	2613	1.00	34T66P	2.61	2.76	1.15	6.53	.99+	0.25	0.22	2.49	0.92	2.81	0.94	12.08	.99+
Gulf of Alaska	540	0.08	P+T	0.54	0.86	0.35	1.76	0.83	0.93	0.61	6.55	.99+	0.00	----	9.24	.99+*
Kodiak	150	0.05	P+T	0.15	0.24	0.10	0.49	0.39	0.00	----	0.00	----	0.00	----	0.49	0.39
Cook Inlet	210	0.03	P+T	0.21	0.34	0.14	0.68	0.49	0.00	----	0.00	----	0.00	----	0.68	0.49
Shumagin	50	0.03	P+T	0.05	0.08	0.03	0.16	0.15	2.14	0.88	0.00	----	0.00	----	2.31	0.90 *
North Aleutian	360	0.20	P+T(3)	0.36	0.58	0.00	0.94	0.61	0.00	----	0.00	----	0.00	----	0.94	0.61
St. George	1690	0.22	50T50P+T(4)	1.69	1.35	0.55	3.59	0.97	0.63	0.47	0.00	----	0.00	----	4.22	0.99 *
Navarin	4800	0.27	P+T+T(5)	4.80	7.68	0.96	13.44	.99+	0.00	----	0.00	----	0.00	----	13.44	.99+
Norton	640	0.15	P+T+T(5)	0.64	1.02	0.13	1.79	0.83	0.00	----	0.00	----	0.00	----	1.79	0.83
Hope	170	0.02	P+T(6)	0.17	0.27	0.00	0.44	0.36	0.00	----	0.00	----	0.00	----	0.44	0.36
Chukchi Sea	2680	0.20	P+T(6)	2.68	4.29	0.00	6.97	.99+	0.00	----	0.00	----	0.00	----	6.97	.99+
Beaufort Sea	1280	0.70	P+T(6)	1.28	2.05	0.00	3.33	0.96	0.00	----	0.00	----	0.00	----	3.33	0.96

EM# - Estimated Mean Number of Spills.

MP_{HC}- Marginal Probability of Commerical Hydrocarbons.

* See footnotes on next page.

** Estimated mean number of oil spills in the planning area as a result of the transportation of oil developed in the other planning areas.

Footnotes for Table IV.B.4-1.

1. Oil spills greater than or equal to 1,000 bbls are considered to be governed by a Poisson process (Smith, and others, 1982, Lanfear and Amstutz, 1983); thus the probability of a specific number of spills (P(n)) occurring is described by the Poisson distribution: $P(n) = e^{-a} a^n/n!$, where n is the specific number of spills (0, 1, 2, ..., n), e is the base of natural logarithms and a is the mean of the Poisson distribution. The probability of one or more spills is calculated as $1 - P(0)$ or simply $1 - e^{-a}$.

   The probabilities for one or more spills associated with the total number of spills in each planning area is calculated as $1 - e^{-a}$, where -a is the sum of the means for each source of spills. This calculation assumes independence between spills from the various sources of spills (e.g., platforms and tankers).

2. The transportation mode symbols have the following meanings: T, 100 percent tanker; P, 100-percent pipeline; 25T75P, 25 percent tanker, 75-percent pipeline; P + T, 100-percent pipeline followed by another 100-percent tanker, and 50T50P + T, 50-percent tanker, 50-percent pipeline followed by 100-percent tanker.

3. All oil from the North Aleutian Planning Area will move via pipeline to Shumagin where it will be loaded onto tankers for shipment to the lower 48 States.

4. One-half of the oil from St. George will be loaded onto tankers for shipment to the lower 48 States. One-half of the 1.3 spills/billion bbls for this tanker shipment is assigned to St. George and the other one-half to the planning area that receives the oil. The other one-half of St. George oil will be piped to Shumagin where it will be loaded onto tankers for shipment to the lower 48 States. Pipeline spillage is assigned to St. George, and one-half of the tanker spillage is assigned to Shumagin, with the planning areas that receive the oil having the other half of the expected tanker spillage.

5. All oil from the Norton and Navarin Planning Areas will be transported by ice breaking tankers to the Shumagin Planning Area where it will be off-loaded and loaded onto tankers for shipment to the lower 48 States. One-half of the expected spillage from the ice breaking leg is assigned to Shumagin as is one-half of the expected spillage from the tanker leg to the lower 48 States. The other half of the expected spillage during the ice breaking tanker leg is assigned as follows: 0.20 spills/billion bbls to area of production (half in-port spills) and 0.45 spills/billion bbls (one-half of the at-sea spills) to St. George.

6. All oil from the Beaufort, Chukchi and Hope Planning Areas will be piped to shore, use the Trans Alaska pipeline and then tanker shipment out of the Gulf of Alaska Planning Area. One-half of the 1.3 spills/billion barrels for tankers is assigned to the Gulf of Alaska Planning Area and the other one-half is assigned to the planning area that receives the tanker shipment.

Table IV.B.4-2
Total Number of Oil Spills Assumed for Each Planning Area for the SEIS Cumulative Case

			ESTIMATED SPILLS FROM OCS PRODUCTION			ESTIMATED SPILLS FROM ALL SOURCES		
PLANNING AREA	OIL (MMBBL)	MPHC*	EM#	TOTAL PROB.	ASSUMED***	EM#	TOTAL PROB.	ASSUMED***
Beaufort Sea	1280	0.70	3.33	0.96	3	3.33	0.96	3
Chukchi Sea	2680	0.20	6.97	0.99+	7	6.97	0.99+	7
Hope	170	0.02	0.44	0.36	0	0.44	0.36	0
Norton	640	0.15	1.79	0.83	2	1.79	0.83	2
Navarin	4800	0.27	13.44	0.99+	13	13.44	0.99+	13
St. George	1690	0.22	3.59	0.97	4	4.22	0.99	4
N. Aleutian	360	0.20	0.94	0.61	1	0.94	0.61	1
Shumagin	50	0.03	0.16	0.15	0	2.31	0.90	2
Kodiak	150	0.05	0.49	0.39	0	0.49	0.39	0
Cook Inlet	210	0.03	0.68	0.49	1	0.68	0.49	1
Gulf of Alaska	540	0.08	1.76	0.83	2	9.24	0.99+	9
Washington/Oregon	180	0.20	0.41	0.34	0	3.16	0.96	3
N. California	420	0.60	0.69	0.50	1	0.69	0.50	1
C. California	300	0.65	0.69	0.50	1	3.98	0.98	4
S. California**	2613	1.00	6.53	0.99+	7	12.08	0.99+	12

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* MP_{HC} denotes marginal probability of commercial hydrocarbons.

** Includes developed and undeveloped reserves. The infrastructure for the Southern California Planning Area includes existing, proposed and hypothetical platforms and development and production wells. Estimates of levels of exploration and development expressed in this table are based solely on the conditional resource level of the planning areas and are therefore, themselves conditional estimates.

*** Based on the estimated mean number of oil spills and a probability greater than 0.40 that one or more oil spills would occur.

MMBBL - Millions of Barrels
EM# - Estimated Mean Number of Oil Spills

Table IV.B.4-1 provides the planning areas and associated conditional oil resource estimates and marginal probability of hydrocarbons in column one, the remaining columns presents the results of the model. The group of columns headed "Spills From OCS Activities Within Planning Areas" present the estimated number of spills (1,000 bbls or greater) within each planning area from development and transportation of the conditional oil resource estimates for each planning area. The columns headed "Tanker Spills From OCS Transport" provide the estimated number of spills in the planning area as a result of the transportation of oil developed in the other planning areas. The column headed "Tanker Spill From Other Domestic" reports the estimated number of spills based upon the estimated volumes of domestic oil, other than OCS oil, expected to move via tankers and barges between U.S. ports over a 30-year period. The column head "Tanker Spills from Imports" provides the estimated number of spills based upon the volume of imports over a 30-year period when distributed between planning areas using the historical average percentages of imports by planning area. All data concerning estimated future domestic non-OCS oil production and imports were provided by the Department of Energy.

b. Oil Spill Cleanup and Containment

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP or Plan) is required by section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act; and by section 311(c)(2) of the Clean Water Act, as amended; and by 33 U.S.C. 1321(c)(2). The Plan provides for a coordinated and integrated response by Departments and Agencies of the Federal Government to protect the environment from pollution. It specifies the division of responsibilities among the Federal, State, and local governments in response to an oil or hazardous substance discharge. A detailed discussion of the various oil spill cleanup and containment equipment and their effectiveness is contained in Section IV.A.4.b (pages IV.A.-41 to IV.A.-45) of the FEIS.

c. Fate of Oil in the Marine Environment

The nature of impacts from oil spills in the marine environment depends largely on the nature and proportions of the oil's chemical components. Weathering processes, in turn, largely depend on oceanographic and meteorologic factors at the time of the spill. A detailed description of the fate of oil in the marine environment is contained in Section IV.A.4.c. (pages IV.A.-46 to IV.A.-52) in the FEIS.

d. Oil Spill Impacts on the Biological Environment

This section of the SEIS tiers directly from Section IV.A.4.d (pages IV.A.-52 to IV.A.-73), FEIS, and incorporates by reference all the information contained in that section. Generic oil-spill impacts on the migratory species are described in Section IV.A.4.d of the FEIS were taken into consideration during the cumulative impact analysis in the SEIS. A detailed discussion on the potential generic impacts associated with oil spills is presented in the FEIS. A brief summary of some of these potential generic impacts, as they relate to the migratory species, is provided.

The severity of oil pollution on different organisms in various habitats varies from no effect to responses of avoidance, decreased activity, physiological stress, and death. Different species react differently, and different lifestages of an organism show different sensitivities to petroleum hydrocarbons. Lethal effects of the soluble aromatic hydrocarbons from bioassay range from 1.0 to 100 parts per million (ppm) for most adult marine organism and from 0.1 to 1.0 ppm of the more sensitive larval and juvenile lifestages. Sublethal effects may occur from soluble aromatic concentrations ranging from 0.1 to 100 parts per billion (ppb) (NRC, 1985).

Although numerous variables may affect toxicity tests, some general patterns of sensitivity to hydrocarbons are evident. In short-term exposure, the sensitivity of marine organisms generally increases from lower invertebrates (enchinoderms, mollusk, annelids) to higher invertebrates (crustaceans, hemicordates) to fish. Some correlations can also be made between the sensitivity of marine organisms to hydrocarbons.

Pelagic fish and invertebrates tend to be most sensitive to hydrocarbons, while benthic and subtidal species are moderately sensitive. The intertidal fish and invertebrates are generally the least sensitive. Marine organisms in the intertidal environment that are exposed to a greater range of naturally occurring environmental factors (temperature, salinity, oxygen) may be physiologically and morphologically better prepared to accommodate an additional stress factor such as petroleum hydrocarbons. Those organisms occupying the more uniform benthic and pelagic environments may be less capable of accommodating to additional stress from the input of petroleum hydrocarbons.

The ecological significance of these responses is important at the population and community levels. Species may be proven sensitive to oil in the laboratory, but in the natural environment, an entire population may recover rapidly because of factors such as effective reproduction and dispersal strategies and immigration. Conversely, although an individual organism may show high tolerance to oil contamination in the laboratory, recovery of that population under natural conditions may never occur or may be delayed due to factors such as competition for food and space or dependence on a specific food resource.

(1) Oil Spill Impacts on Marine Mammals

The most likely effects of oil on marine mammals based on laboratory research (Geraci and St. Aubin, 1985; Goodale, et al., 1981; and Gruber, 1981) are (a) a mild deleterious but reversible effect on the skin; (b) possible eye irritation, which would be reversible unless exposure was prolonged; (c) possible short-term baleen fouling (baleen whales) with possible feeding reduction for 1 or 2 days; (d) possible blowhole fouling and death due to respiratory stress for very young animals in heavy oil; and (e) temporary food reduction or contamination, and oil ingestion. Potential but unlikely effects include: (a) possible mortality due to respiratory stress; (b) possible immediate mortality to young or already stressed animals due to ingestion of oil or inhalation of vapors; and (c) possible mortality due to stress if individuals are already stressed.

(2) Oil Spill Impacts on Birds

Birds which spend much time on the sea surface are especially vulnerable to oil spills (King and Sanger, 1979). Mortality results primarily from hypothermia as oil mats the plumage destroying the thermal barrier. Direct contact by birds with oil of appreciable amounts is usually fatal.

Abnormalities in bird reproductive physiology and behavior resulting from ingestion of oil potentially could have substantial adverse effects on egg production in seabird and water fowl populations (Hartung and Hunt, 1966; Stickel and Dieter, 1979; Ainley et al., 1981; Homes, 1984; Peakall et al., 1081; and Gorsline and Homes, 1982). In addition, transfer of oil from adults to eggs results in reduced hatchability, increase incidence of deformity, and reduced growth rates in young birds (Grau et al., 1977; Albers, 1978; and Szaro et al., 1978). Holmes et al. (1978) have shown that stress from ingested oil can compound ordinary environmental stress. Presumably, the effects of external oiling would also be more severe when birds are under environmental (eg., winter) or physiological (eg., molting) stress.

(3) Oil Spill Impacts on Fish Resources

The effects of an oil spill on fish resources varies. Oil spills have been shown to kill adult fish, contaminate fish, and reduce the growth of fish, and perhaps decreasing fish recruitment (Howarth, 1987). Teal and Howarth (1984) suggests that although adult fish can be killed by oil spills, this probably poses less of a threat to commercial fisheries than does damage to eggs and larvae, or changes in the ecosystem supporting the fishery.

Egg and larvae mortalities are critical because these early life stages are often planktonic and, therefore, unable to avoid spills. In addition, toxicity thresholds are lower at these stages. Adults are not resistant to the effects of an oil spill; however they exhibit greater toxic resistance and responses rather than direct mortality. Such responses to oil spills often include avoidance behavior (Nelson-Smith, 1973; Weber et al., 1981) or sublethal responses which are difficult to evaluate. There is even some evidence suggesting that fish do not always avoid areas of contamination (Blumer, et al., 1971; Gooding, 1971). Studies of actual open-water spills have concluded there has been no detectable reduction in fishery harvest as a result of these spills (MacIntyre, 1982; Sherman and Bush, 1978; NAS, 1985).

Salmonids are more sensitive than benthic fish species to hydrocarbon exposure (Wilson, 1972; Rice, et al., 1979). Newly emerged salmon fry are the most susceptible life stage (Rice, et al., 1975; Moles, 1979). Pelagic adults in the upper water column may contact an offshore oil spill or the water-soluble fraction below a spill and experience mortality or sublethal effects.

Spilled oil could have a significant impact on salmon and other anadromous fishes. These fish use chemical clues to return to their spawning streams (Fry, 1973); oil therefore, could interfere with their olfactory senses. Impacts could be especially severe during smolting, when the young fish first enter the ocean, and during when they try to locate their home drainage during spawning.

Studies have shown that various life stages of salmon can detect even sublethal hydrocarbon concentrations (Rice, 1973; Weber, et al., 1981) and may avoid such areas. Avoidance of a home spawning streams due to an oil spill which contacted estuarine areas could have an adverse effect on part of a population by reducing spawning. Malins, et al., (1978) found that salmon's homing ability was delayed, but not prevented, by contact with hydrocarbons.

5. Noise and Other Disturbances

This section of the SEIS tiers directly from Section IV.A.7, (pages IV.A.-73 to IV.A.-110) FEIS and incorporates, by reference, all the information contained in that section. The information presented in Section IV.A.7 was taken into consideration during the cumulative impact analysis for the SEIS. A detailed discussion on the potential generic impacts associated with noise and other disturbances is found in the FEIS. However, a brief summary of some of these potential generic impacts as they relate to the migratory species is provided.

Noise emissions resulting from offshore development are associated with the operation of offshore platforms, drilling rigs, seismic, geophysical surveying, petroleum transfer facilities, onshore processing plants, pump stations, aircraft and vessel. In addition, construction equipment used during the installation of the various facilities emits various amounts of noise. The degree of noise impact depends upon the emitted sound level and the proximity of the source.

The response of animals to acoustic stimuli has generally shown variability in behavioral and physiological effects, depending on species studied, characteristics of the stimuli (ie., amplitude, frequency, pulsed, or nonpulsed), season, ambient noise, previous exposure of the animal, physiological or reproductive state of the animal, and other factors. Possible adverse effects from loud sounds include: (1) auditory discomfort due to loudness/pressure changes: (2) possible hearing loss; (3) the potential masking of sounds that might be used in intraspecies communications; (4) behavioral responses resulting in avoidance of an area; and (5) decreased feeding ability.

a. Marine Mammals

Subsea noise may affect marine mammals by disturbing or alarming them and causing them to flee the sound source. Intense noise could damage the hearing of marine mammals or cause them other physical or physiological harm (Geraci and St. Aubin, 1980; Hill, 1978). Frequent and/or intense noise that causes a flight or avoidance response could permanently displace the animals from important habitat areas.

The presence of sea lion, elephant seal, and cetacean populations in proximity to human activity and marine-vessel traffic along the California coast and the presence of sea lions, seals, and beluga whales near commercial fishing traffic in Bristol Bay and Cook Inlet in Alaska strongly suggest that some marine mammals have adjusted to human activities with no apparent adverse effects. However, some species of marine mammals, such as fur seals, are probably more sensitive to human presence and disturbance, particularly during the nursing and breeding seasons.

A task force report on geophysical operations in 1982 found there was no evidence to suggest that airguns and other nonexplosive acoustic sources cause injury to marine mammals, including gray whales.

b. Coastal and Marine Birds

Human activities associated with exploration, development, and production especially air and vessel traffic near nesting waterfowl and seabirds, could reduce productivity of some species and may cause abandonment of important nesting, feeding, and staging areas. The responses of birds to human disturbances vary. These responses depend on the species, physiological or reproductive state of the birds, distance from the disturbance, type, intensity, duration of the disturbance, and may other factors. Waterfowl nesting on deltas and islands may also be disturbed by aircraft and vessel traffic.

Helicopter and vessel traffic servicing drilling rigs or platforms would constitute the most important source of disturbance affecting marine birds. Onshore activities near seabird colonies and waterfowl and shorebird staging and nesting areas can disrupt breeding activities and preparation for migration. Nesting birds may be subjected to increased predation pressure from predatory species which have adapted to human presence. Construction operations of onshore facilities may encroach upon wildlife habitat, causing nearby breeding areas to be abandoned.

Low flying aircraft, especially helicopters, can frighten large numbers of cliff nesting birds from the nesting ledges, resulting in displacement of eggs and/or young. Disturbance of birds in important feeding, staging, and wintering areas can cause excessive expenditure of energy and displacement of less favorable habitats during critical periods in the migration cycle.

c. Fish Resources

Use of airguns is prevalent and is relatively harmless to fish (Weaver and Wienhold, 1972; Falk and Lawrence, 1973). However, airguns can harm a small percentage of fish eggs that are within 0.5 m from the source (Kostyochenko, 1973). Water guns, which will be used for high-resolution surveys, produce much less energy than airguns and are not known to have any effect on fish. High explosives, although rarely used, can be lethal to fish and can result in rupture of the swim bladder, abdominal cavity, blood vessels, and internal organs, and in tearing of muscle tissue (Falk and Lawrence, 1973).

C. Projects Considered In Cumulative Impact Assessment

This section describes non-OCS projects and proposals and existing oil and gas infrastructures which are part of the existing environment or are reasonable foreseeable future actions. The SEIS tiers on the FEIS and incorporates by reference those projects and proposals that were previously considered during the cumulative impact analysis in Section IV.B for each planning area. The following discussion is a summary of these projects and proposals which have been updated to reflect any changes in their status. New projects and proposals since the publication of the FEIS have been added.

1. Dredging and Marine Disposal Activities

a. Alaska Region

The Snake River which enters the Norton Sound at Nome is dredged annually. Approximately 13,000 cubic yards of sediment are removed each year and deposited about 1/2 mile east of the mouth of the river. These dredge spoils are contaminated by mercury that was released into the environment during the years that mercury was used for the processing of gold. Data that have recently been made available have led the Environmental Protection Agency to review the decision to use this offshore disposal site.

b. Pacific Region

In the Pacific Region a variety of materials have been and are being dumped offshore: dredge spoils, low level radioactive wastes; obsolete munitions, and industrial and municipal wastes. Ocean dumping of acceptable waste materials is authorized under Title I of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401), and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251). The EPA administers the designation and management of ocean disposal areas and permits for dumping of all acceptable wastes except dredged materials. Sections IV.B.7 (pages IV.B.7.-3 to IV.B.7-5), IV.B.8 (pages IV.B.8.-2 and IV.B.8.-3), IV.B.9 (pages IV.B.9.-4 to IV.B.9.-6), and IV.B.10 (pages IV.B.10.-3 to IV.B.10.-6), of the FEIS contain a detail description of the location and the wastes designated for disposal at these sites.

2. Commercial Fisheries

a. Alaska Region

Waters off the coast of Alaska support some of the most productive fisheries in the world. In 1986, the ex-vessel value of Alaskan commercial fisheries totaled about $955 million. The salmon fishery was valued at $404 million, with a 5-year (1982-1986) average value of $354 million. Fisheries for groundfish, primarily pollock, sablefish, sole, cod, and other flounders, were valued at about $268 million. The shellfish fishery, mainly for crab, while below recent former harvest levels, has experienced increasing price levels and was valued at $182 million (NPFMC, 1989). The ex-vessel value of the 1986 herring harvest was $39 million (T.Smith, NPFMC, 1989, personal communication).

All Alaska OCS Planning Areas support commercial fishing to some degree, although the fisheries in the Beaufort and Chukchi Sea Planning Areas are of relatively minor importance. To some degree, all coastal communities in Alaska derive economic benefit from commercial fishing; however, in landings and value, Dutch Harbor, Kodiak, Naknek, Cordova, Sitka, and Petersburg rank as the major fishing ports in the Region.

Alaskan commercial fisheries employ gillnets, seines, and trolling gear for harvesting salmon; longlines for halibut, sablefish, and rockfish; and trawls for other groundfish. Pots of various types are used in the crab fisheries. The limited spring and summer herring roe/bait fisheries also employ gillnets and purse seines.

In addition to the commercial fisheries there are saltwater coastal sport fisheries for salmon, halibut, and other marine fishes. Sport fishermen also harvest shellfish (crab, shrimp, and clams). While of lesser economic value than commercial fisheries, the value of the sport fishery is significant and projected to increase rapidly with the growth in population.

b. Pacific Region

(1) Pacific Salmon

The major species of salmon caught by commercial and sport fisheries offshore California, Oregon and Washington are chinook, coho and pink salmon. Long-term (1971-1988), coastwide (i.e. California, Oregon and Washington) commercial and sport landings data have been summarized by the PFMC (1989) for these three species. Chinook and coho landings within this three State area declined substantially between 1971-1985; however, in recent years the total chinook and coho landings have been increasing. Between 1986-1988, for example, the total area-wide landings of chinook increased from approximately 1.4 to 2.1 million fish, while the landings of coho have ranged from approximately 880,000 to 1.1 million fish.

Although highly variable between species and individual stocks, the ocean harvest of salmon may represent a substantial portion of runs that support one or more stocks in any given year. For example, the harvest rate of chinook produced from the central valley (i.e. Sacramento-San Joaquin system) of California from 1970-1987 has been estimated to range from 50 to nearly 80 percent of the total run (i.e. the estimated catch plus the estimated escapement). A substantial area-wide reduction in landings for both species, largely as a result of El Nino conditions, occurred from 1983-85. This effect was especially pronounced in Oregon and Washington.

Pink salmon landings, which run on an odd-year cycle in the Pacific Region, increased throughout the 1970's to a peak in 1979, but have subsequently decreased. In recent years, area-wide landings of pink salmon ranged from 42,000 in 1987 to 171,000 fish in 1985.

The majority (50-60 percent) of chinook are landed and presumably caught in California, with the remainder landed in Washington and Oregon. In contrast,the vast majority of coho are caught and landed in Washington and Oregon, with relatively smaller numbers taken in California. Pink salmon are landed principally in Washington, with relatively small numbers of fish from Oregon and virtually none form California. Over the period from 1971-1985, the vast majority (70-80 percent) of chinook, coho and pink salmon landed area-wide have been taken by the commercial troll fishery, with the balance taken by sport fishermen.

(2) Steelhead Trout

Commercial fishing for steelhead has been prohibited in California since the mid-1920's, and the resource is now managed exclusively as a sport species. Most steelhead are caught in rivers rather than offshore. The three most important steelhead rivers are the Klamath and Eel Rivers in northern California, and the Sacramento River which empties into San Francisco Bay in central California. In Washington and Oregon steelhead are currently managed exclusively for recreational and tribal Indian fisheries.

Most steelhead are caught in rivers rather than in marine waters, although there a few areas off the outer coast of Washington and in Puget Sound where fish are consistently taken. The majority of fish caught upstream are taken by recreational fishermen, while most fish caught near the river mouths are taken by treaty Indians. As a result of a Federal Court Ruling (i.e. the so-called Boldt decision), the steelhead catch in Washington State is presently allocated on a 50:50 basis between treaty Indians and non-treaty recreational fishermen. During 1983-84, for example, approximately 105,000 steelhead (both winter and summer run fish combined) were taken by recreational fishermen, while approximately 80,000 steelhead were taken by treaty Indians.

Over the years 1973-84, a period during which the Boldt decision was in force, the Washington State-wide sport catch for winter- and summer-run steelhead, ranged between approximately 40,000-110,000 fish, and 15,000-60,000 fish, respectively. Based on the 50:50 allocation system resulting from the Boldt decision, it is likely that treaty Indians harvested roughly equal numbers of fish as well.

(3) Pacific Whiting

The annual catch of Pacific whiting from foreign, joint-venture (JV) and domestic fisheries in U.S. waters offshore California, Oregon and Washington averaged approximately 125,000 mt between 1966-1986 (PFMC 1987). Annual catches were highest, and almost exclusively the result of foreign fishing effort, from 1966 until 1977. Since 1980 the annual catch of whiting has generally decreased, with most of the catch taken by JV or foreign fishing effort. The annual catch quota and the Acceptable Biological Catch (ABC) for whiting in U.S. waters offshore California, Oregon and Washington have generally been increased since 1977, although the actual catch levels have yet to exceed these recommended limits. The ABC was increased from 206,000 mt in 1987 to 325,000 mt in 1988.

3. Anadromous Fish - Freshwater Habitat

The freshwater spawning and rearing grounds and riverine migration routes used by anadromous salmonids such as Pacific salmon and steelhead trout are especially critical portions of their habitat since the productivity of individual stocks is directly related to the amount and quality of this habitat. The PFMC (1981) reviewed historical problems with, and the status of, freshwater habitat for anadromous salmon stocks in California, Oregon and Washington. In particular, the PFMC cited the many serious problems associated with hydroelectric dam construction and operation.

For example, construction of hydroelectric projects has flooded or blocked access to productive spawning habitat, while the operation of these facilities has resulted in reduced flows during migration and in spawning areas, increased turbidity and sedimentation of gravel, and temperature modifications. Such changes have completely eliminated many areas from salmon production, and have seriously reduced salmon production potential in other areas.

The PFMC review also cited poor land and water use practices such as logging, road building, water diversions, streambed alterations and pollution as factors responsible for subtantially reducing or degrading the critical freshwater habitat. Based on the freshwater habitat review presented by the PFMC (1981, see Table A-1), substantial historical reductions in critical spawning and rearing habitat have occurred for many salmonid stocks in the California central valley (i.e. the Sacramento and San Joaquin system) and the Columbia River drainage systems. Based on the trend existing at the time of their review (1978) the PFMC (1981) estimated that habitat availability in all major river systems and coastal streams within California, Oregon and Washington would continue to decrease, or at best remain unchanged, over the next 10-20 years. Even with habitat rehabilition efforts, the PFMC (1981) estimated relatively little improvement in habitat availablity would be likely to occur over the next 10-20 years.

Although there are no current estimates of habitat availability, many of the same activities (i.e. hydroelectric plant operation and water diversions) that have resulted in habitat loss or degradation still continue. Efforts to mitigate or rehabilitate degraded freshwater habitat are in progress or planned in some areas (e.g. the Upper Sacramento River), and there is increasing recognition (California Advisory Committee on Salmon and Steelhead Trout, 1988) that substantial action is required to arrest the long-term trend of habitat loss and degradation, and reduced salmon production.

4. Subsistence Activities

Subsistence hunting and fishing are important from both a cultural aspect and in terms of providing a major source of food for native and rural Alaskans. The following information is summarized from the Proposed 5-Year Outer Continental Shelf Oil and Gas Leasing Program Mid-1987 to Mid-1992, FEIS (DOI, MMS, 1987) which is hereby incorporated by reference. The species used vary somewhat in different portions of the State and from community to community; however, in general, marine mammals and fish are important in most coastal areas.

Important subsistence resources for those communities bordering the Gulf of Alaska, Cook Inlet, and Prince William Sound include salmon, halibut, other marine fishes, freshwater fish, shellfish, intertidal resources, small marine mammals, waterfowl, and upland game.

Communities along the southern Bering Sea harvest salmon, halibut, shellfish, intertidal organisms and plants, fur seals, hair seals, sea lions, birds and bird eggs, and caribou. Communities bordering the northern Bering Sea utilize salmon and other fishes; shellfish; bearded, ringed, and spotted seals; walrus; bowhead and beluga whales; waterfowl; moose; reindeer; and caribou.

Communities bordering the Chukchi and Beaufort Seas depend heavily upon marine mammals. Resources utilized include bearded, ringed, and spotted seals; walrus; bowhead and beluga whales; polar bear; freshwater and ocean fish; waterfowl; birds and bird eggs; caribou; moose; Dall sheep; berries; and vegetation.

5. Municipal Wastes and Other Onshore Effluent

Historically, the Nation's rivers, estuaries, and coastal waters have received municipal waste discharges since collection and treatment of domestic wastes were initiated. Prior to the 1970's, ocean disposal was largely unregulated, and adverse impacts on human health and the environment were observed.

The major point source discharge of waste materials into nearshore and coastal areas comes from sewage treatment facilities, industrial facilities, and electric generating facilities. These discharges are regulated by the EPA. The effluent from the industrial and sewage treatment facilities may contain, even after treatment, substantial quantities of synthetic organics, heavy metals, suspended solids, oxygen-consuming materials, and nutrients. Sewage effluent may also contain fecal coliform and potentially pathogenic microorganisms. Powerplants cooling waste discharges may be elevated in temperature and have increased chlorine levels.

Contaminants from marine transportation activities enter the sea intentionally as a result of routine operational discharges and unintentionally as a result of accidental spills. With respect to ships that maintain sizeable crews, the pollutants are the large amounts of domestic waste products such as sewage, food waste, plastic debris and trash from human activities on board. For recreational vessels, sewage disposal from marine sanitation devices in highly populated, confined harbors and anchorages is the primary pollution concern.

In contrast to the important progress made during the 1970's in controlling industrial point source discharges and in upgrading municipal sewage treatment facilities, progress with non-point sources is negligible (CEQ, 1980) Non-point source pollution is primarily the result of precipitation falling and moving over and through land and into surface waters. In some cases, non-point source pollution is the result of human practices such as agriculture and irrigation. All land-use activities are potential non-point source of pollution. Such sources are classified as urban and non-urban runoff. Pollution discharges from non-point sources greatly exceed the discharge from point sources.

Municipal wastes and other onshore effluent are discussed in by planning area for the Pacific Region in Section IV.B.7. (page IV.B.7.-8), IV.B.8. (pages IV.B.8.-4), IV.B.9. (page IV.B.9.-7), IV.B.10. (page IV.B.10.-18).

6. Coastal Development in California

Between 1945 and 1975, California's population tripled to more than 20 million with 85 percent of the population living within 30 miles of the coast. At the turn of the century, it was estimated that California had 381,000 acres of prime coastal wetlands. Within 75 years about two-thirds of this acreage had been lost to a variety of developments along the coast. These disturbances have ranged from large-scale, whole-ecosystem elimination to small-scale, habitat-specific alterations. They include urban development, harbor construction, dredging, dike and levee development, and marina development - just to name a few (Speth 1979; Zedler 1982; Zentner 1988).

This dramatic loss of habitat is not without corresponding loss in plant and animal species. In fact, almost all of the species listed as threatened, endangered, or candidate by USFWS can trace their declines to past over-hunting or habitat loss by coastal development.

7. Onshore Oil and Gas Related Activities

The ANWR is situated in the northeastern part of Alaska. The boundaries of the coastal plains portion of the ANWR facing the Beaufort Sea extend from the Canning River Delta on the west to the Canadian border on the east.

Controversy as to whether or not the coastal plain of ANWR should be open for oil and gas exploration and development led Congress to create Section 1002 of the Alaska National Interest Lands Conservation Act (ANILCA). This section laid out guidelines for the Secretary of the Interior to follow prior to reporting to Congress recommendations for the use of the coastal plain, or 1002 area. The FWS released its final legislative Environmental Impact Statement (FLEIS) on the potential effects of exploration and development on the coastal plain in April 1987 (DOI, FWS, 1987). The FLEIS analysis was based on a 250-kilometer pipeline that would extend from the easternmost development hypothesized in the ANWR to TAPS Pumping Station No. 1.

The conditional, economically recoverable resource in the mean case was estimated at 3.2 billion bbls with a 19.0-percent probability of oil being present. Approximately 5,120 hectares, or 0.8 percent of the

1002 area, would be modified from its initial condition. Approximately 320 to 500 kilometers of all-season gravel roads within several oil fields and about 180 kilometers of road between the Canning River and the marine facilities at Pokok Lagoon are assumed.

The Secretary of the Interior recommended to Congress that the entire Arctic Refuge coastal plain (Alternative A) be made available for oil and gas leasing. Section 1003 of the ANILCA states that "production of oil and gas from the Arctic National Wildlife Refuge is prohibited, and no leasing or other development leading to production of oil and gas from the range shall be undertaken until authorized by an act of Congress." Legislation authorizing leasing of ANWR lands which was introduced in Congress has been postponed as a consequence of the Valdez oil spill. The fate of the legislation is uncertain at this time.

8. Existing Federal and State Oil and Gas Activities

a. Alaska State Oil and Gas Activities

A total of 27 lease sales have been conducted by the Alaska Department of Natural Resources since the institution of the five-year leasing program in 1979. Currently producing offshore leases are located in Cook Inlet and the Beaufort Sea. Most of the oil produced from Cook Inlet is transported by tanker from Nikiski through lower Cook Inlet and the Gulf of Alaska. Oil produced from the Beaufort Sea is transported via pipeline to the Trans-Alaska Pipeline System.

Sixteen sales are included on the current Five-Year Oil and Gas Leasing Program (1989-1993). Seven of these sales are offshore. All offshore sale areas are located in the Beaufort Sea or Cook Inlet. Two recent sales leased tracts in the Beaufort Sea. In Sale 55, tracts from just west of Kaktovik eastward to the Canadian border were leased, and in Sale 52, tracts were leased in the area of Smith Bay. Exploration activities have not yet occurred on tracts leased in these sales.

b. Endicott Oil and Gas Activities

The Endicott Oil and Gas Development and Production Project includes 2 gravel islands that are located approximately 4 kilometers offshore and 24 kilometers east of Prudhoe Bay; a 5-kilometer solid-fill gravel causeway connecting the 2 drilling islands; a 3-kilometer gravel causeway with 213 linear meters of breaching extending from the Sagavanirktok (Sag) River Delta to the interisland causeway; a 2.5-kilometer gravel-causeway approach through the Sag Delta and a 14-kilometer gravel road through Sag Delta wetlands that connects with the existing Prudhoe Bay road system at Drill Site 9; elevated oil pipelines along the onshore road segments to Trans-Alaskan Pipeline System Pump Station No. 1; and an onshore disposal pit to contain drilling discharges determined to be unsuitable for offshore disposal.

c. Seal Island

Seal Island is constructed on a lease obtained by Shell Oil company during the Joint Federal-State Beaufort Sea Lease Sale held in 1979. Recovery of 300 million bbls of oil has been estimated from a discovery announced by Shell in January 1984. Shell would like to start producing about 100,000 bbls per day of oil, possibly by 1992. An oil discovery from Northstar Island, about 4 kilometers northwest of Seal Island, was announced in January 1986. That discovery helped to define the Seal Island reservoir (Alaska Report, Jan. 22, 1986). Amerada Hess drilled one well and spudded a second from Northstar during the 1985-1986 winter drilling season (Van Dyke [State of Alaska, DNR], 1987, pers. commun.).

d. Niakuk Development Project

British Petroleum Exploration plans to develop the Niakuk hydrocarbon reservoir in the Alaskan Beaufort Sea. The project is located off Heald Point at the northeast quadrant of Prudhoe Bay. The major components of the project, as originally proposed, involve expanding an existing offshore artificial gravel island located in about 4.50 feet of water, constructing a 1.25-mile long gravel causeway (including a 350-foot breach to mitigate fishery impacts) from shore to the island, and constructing a 1.75-mile gravel road from the point of landfall of the causeway to an existing production pad. The permit request for the gravel causeway was denied by the Army Corp of Engineer's District Engineer, but that decision is now under reconsideration. Other project components would include pipelines paralleling the new and existing gravel construction and possibly production modules on the island. The production island will accommodate 14 wells. Initial oil production would be about 20,000 bbls per day, and the life of the project is estimated at 15 years.

e. Alaska Federal Oil and Gas Activities

The following lease sales have occurred within the Alaska OCS Region. Exploration activities have occurred within each of the sale areas except the North Aleutian Basin. Active leases remain within these sale areas and additional exploration activities could be forthcoming.

Lease Sale BF - Beaufort Sea
Lease Sale 71 - Diapir Field
Lease Sale 57 - Norton Sound
Lease Sale 70 - St. George Basin
Lease Sale 83 - Navarin Basin
Lease Sale 87 - Diapir Field
Lease Sale 92 - North Aleutian Basin

Activities associated with exploration are discussed within section IV.A. of the FEIS. Exploration activities could include exploratory drilling from a jack-up rig, semi-submersible drilling unit, drillship, bottom-founded drilling unit, or artificial island; helicopter support operations; support vessel operations including ice management in the northern sale areas; and high-resolution shallow-hazard seismic surveys.

To date there have been no proposals for development and production within the Alaska OCS Region. Should oil and/or gas be discovered in commercially producible quantities on leases within one or more of the aforementioned sale areas, development and production activities as described in section IV.A. of the FEIS could occur. Transportation of produced product may occur by pipeline or tanker and could transit several planning areas.

f. Northern and Central California Federal Oil and Gas Activities

Section IV.B.8 (page IV.B.8.-4) and IV.B.9 (page IV.B.9-4 to IV.B.9.-7) in the FEIS for the Proposed Program discusses the existing oil and gas activities and infrastructure within the Northern and Central California Planning Areas, respectively. The only Federal lease sale (Northern and Central California, P-1) in the Northern and Central California Planning Area occurred in May 1963.

From July 1964 when Exxon drilled the first well off the coast of Humboldt county through November 1966, a total of seven exploratory wells were drilled in the Northern California Planning Area. Three wells were drilled by Shell in 1965-1966 in the Point Arena Basin following the 1963 OCS lease sale. In the offshore Eel River Basin, four exploratory wells were drilled between 1964 and 1965. There has been no development or production in the area.

Between September 1963 and September 1967, Shell Oil Company drilled twelve exploratory wells in the Central California Planning Area. Ten wells were drilled in the Bodega Basin, beginning in 1963, and two wells were drilled in the Ano Nuevo Basin, beginning in 1967, on leases issued in the 1963 OCS lease sale. All oil and gas leases have now expired in the area.

g. Southern California Federal Oil and Gas Activities

Section IV.B.10 (pages IV.B.10.-9 to IV.B.10.-16) in the FEIS for the Proposed Program discusses the existing oil and gas activities and infrastructure within the Southern California Planning Area. In the Southern California Planning Area, eight OCS lease sales and one reoffering sale have been held.

While oil production commenced off southern California in 1896 with the development of the Summerland Field in State waters, exploration began in Federal waters in the Santa Maria Basin in 1964 with the drilling of exploratory wells following the first Pacific oil and gas lease sale in May 1963. Chevron Oil Corporation drilled the first well in Federal waters in September 1964, off the coast of San Luis Obispo County. Twelve fields are located in the onshore portion of the basin, with one field on production in the offshore portion. One COST well was completed in 1978. As of September 1988, 296 exploratory wells had been drilled in the Southern California Planning Area.

Following the discovery of the Dos Cuadros oil field by Phillips Petroleum Company in 1967, exploration activities in the Pacific OCS focused on the Southern California Planning Area. A record number of 38 exploratory wells were drilled in the Pacific OCS in 1968. This exploratory activity in 1968 led to the discovery of the Hondo, Government Point, Pescado, and Secate Fields in the Santa Ynez Unit and increased industry's interest in the oil and gas potential of the Pacific OCS Region.

Exploration activities increased from 1974 through 1977, as industry further defined the oil and gas potential of the Southern California Planning Area. After a slight decline, exploration began a steady increase in the early 1980's as lease sales offered new acreage for offshore operators to explore. Since that time, the pace of exploratory drilling in the Pacific OCS has declined, as offshore operators focused their attention on development and production operations.

Twenty four offshore fields are located in five major areas of the Southern California Planning Area; i.e., Point Arguello/Gaviota, Santa Ynez/Las Flores Canyon, Point Pedernales/Lompoc, San Miguel/South Nipomo Mesa, and Santa Clara/Ventura. Fourteen fields capable of commercial production have been discovered in the Santa Barbara Channel in Federal waters since the advent of drilling there in 1967. Further fields are currently on production.

Two oil fields have been discovered offshore San Pedro in the inner banks area of the southern California borderlands. Of the total wells in the planning area only nine exploratory wells, commencing in 1976, have been drilled in the outer banks area. As of September 1988, 661 development wells have been drilled from 21 permanent production platforms. The cumulative production from this area, from its beginning in 1968 through 1987 has been approximately 403 million bbls of oil and slightly less than 284 billion cubic feet of natural gas. Annual production is about 33 million bbls of oil and 45 billion cubic feet of gas.

Development and production plans have been approved or are under consideration for four additional field projects involving six new platforms. In the Santa Ynez Unit, three additional platforms are proposed for installation; i.e., Harmony/60 well slots/in 1992, Heritage/60 well slots/in 1992, and Heather/28 well slots/in 1995. Platform Julius was proposed to be installed in 1988 with 70 well slots in the San Miguel Field. A San Luis Obispo voter initiative disapproved the installation of Platform Julius. Platform Independence is proposed to be installed in 1992 with 60 well slots in the Point Pedernales Field but may not be needed for development. Platform Hacienda is under consideration for the Rocky Point Field but no official development and production plan has been received.

h. Southern California State Oil and Gas Activites

There are 51 active leases on State offshore lands covering 161,000 acres. Twentynine are off Santa Barbara County, 10 are off Orange County, and 12 are off Ventura County. Nine platforms and seven production islands are presently operating on these leases. Four of the manmade islands are inside the Los Angels/Long Beach Harbor Breakwater. The last State offshore lease sale was held in 1969. A description of the offshore field within the 3-mile limit of the State's jurisdiction is contain in Section IV.B.10 (pages IV.B.10.-6 to IV.B.10.-8). The following is an update of several of the development projects in State waters.

(1) Shell Hercules Project

Shell proposes to install one platform and subsea pipelines to shore off Molino (28 miles west of Santa Barbara). The project includes modification of existing processing facilities at Canada del la Huerta. The development plan has been submitted to State and local agencies and the environmental documentation is currently under development.

(2) Arco Coal Oil Point Project

Arco proposed to install three platforms (Heron, Hawk, and Haven) and subsea pipelines to shore offshore Coal Oil Point (10 miles west of Santa Barbara). The proposal includes the installation of oil and gas processing facilities, and onshore pipelines to treatment facilities. The development plan has been submitted to State and local agencies. An Environmental Impact Report has been developed on the project. The State Lands Commission is conducting a 2 year (1987-1989) study of the cumulative effects of the project.

(3) Union Cojo Project

Union proposes the installation of a platform (Haley) and subsea pipeline offshore Point Conception. The proposal includes onshore pipelines from the platform to Union's Lompoc oil dehydration facility. A development plan has been submitted to State and local agencies.

i. Canadian Beaufort Sea Oil and Gas Activities

The following information concerning Canadian Beaufort Sea oil and gas activities is summarized from Campbell (1989). Eighty wells have been drilled to date in the Canadian Beaufort Sea. There have been 26 significant discoveries encompassing an estimated 1.5 billion barrels of oil and 4.5 trillion cubic feet of natural gas. The giant Amauligak oil and gas field will likely be the lead offshore oil development project, although plans are on hold at present. Current transportation concepts suggest that oil from Amauligak will be shipped by pipeline from the production islands to shore at Richards Island and then down the Mackenzie Valley to southern markets. There are currently 9 offshore exploration licenses in good standing. These licenses are due to expire in 1990 or 1991.

9. Transportation of Oil and Gas

a. Cook Inlet Tankering

An increase in Cook Inlet-produced oil may be shipped to markets in the Far East if allowed by Congress. Laws currently restrict the export of oil produced from Federal and State leases in Cook Inlet to 3,000 bbls per day (about two tankers per year), the current level of export. However, efforts are under way by Alaska's congressional delegation to end these restrictions. If the restrictions are removed, it is estimated that 36 MMbbl of oil may be tankered over the life of the Cook Inlet Field. This could amount to an average of about 14 tanker trips per year. It is believed that the tankers would travel the great circle route from Cook Inlet to Pacific Rim markets, which would result in tankers traveling through Unimak Pass and then westward just north of the Aleutian Islands. Alaska OCS Planning Areas likely to be affected would include Gulf of Alaska/Cook Inlet, Kodiak, Shumagin, and St. George Basin.

b. Trans-Alaskan Pipeline System

The majority of the oil produced in Alaska is transported via the Trans-Alaskan Pipeline System (TAPS). The TAPS began transporting crude oil from the Alaska North Slope to Valdez on June 10, 1977. The TAPS is a 48-inch diameter pipeline designed to have a potential capacity of 2.0 million bbls per day, although 1.7 million bbls per day has been set as the maximum efficient rate by the Alaska Oil and Gas Conservation Commission.

The terminal at Valdez is able to handle four tankers at one time and has an average turnaround time of 24 hours. The TAPS is presently delivering crude oil from Prudoe Bay which initially has an estimated 9.6 billion bbls of recoverable oil reserves and from Kuparuk which has an estimated 1.6 billion bbls of recoverable oil reserves.

A total of 2.0 million barrels per day is tankered out of Alaska. Of this, about 680 thousand barrels per day are tankered into ports within California.

c. Trans-Alaska Gas System

The Yukon Pacific Corporation proposes to construct the Trans-Alaska Gas System (TAGS). This system would transport natural gas from Alaska's North Slope via a 36-inch outside diameter pipeline to a tidewater facility at Anderson Bay, Port Valdez, Alaska. The proposed TAGS closely parallels the existing TAPS oil pipeline. Up to 2.3 billion cubic feet of conditioned natural gas per day would be moved through TAGS. At Valdez, the natural gas would be converted to liquefied natural gas for export by tanker to markets in the Asian Pacific Rim.

10. Nonenergy Minerals

a. Red Dog Mine

The Red Dog Mine is located 87 kilometers from the Chukchi Seacoast and 145 kilometers north of Kotzebue. The seaport for the mine is located approximately 27 kilometers southeast of Kivalina. Production is scheduled to begin in 1990 with 1.1 million metric tons of ore. Full production at a rate of 1.9 million metric tons per year is expected to begin in 1993 and continue into the future. Variations in production after 1992 will reflect different percentages of lead, zinc, and other mineral concentrates in the ore that is mined. At full production, 5.5 thousand metric tons of ore per day would be mined.

The port facility consists of a dock and causeway 40 meters wide and 60 meters long that extends into a water depth of 4 meters. Ore will be loaded from a dock that consists of 3 cells 23 meters in diameter that are filled and connected with a covered conveyer system and walkway. This dock will be about 210 meters long and extend to a water depth of 5.5 meters. Ore shipping will occur only during open-water periods (approximately 90 to 100 days/year). Ore will be loaded onto lightering vessels which will make four trips per day to ore carriers which will be loaded offshore. Ore carriers will make about 15 trips per year to smelters on the Pacific Coast of North America, the Far East, and Europe. The life of the field is estimated at 50 years. The port facility is located adjacent to the Hope Basin Planning Area.

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b. Federal Offshore Mining Program - Norton Sound Lease Sale

The following information regarding the OCS Mining Program Norton Sound Lease Sale, and offshore mining in State waters was derived from the OCS Mining Program Norton Sound Lease Sale DEIS (DOI, MMS, 1988) which is hereby summarized and incorporated by reference. The proposed action consists of 40 blocks to be offered for lease in July 1989. The total areal extent of the proposed Norton Sound Lease Sale is about 72,148 hectares (approximately 178,282 acres). The blocks that comprise the proposed action are located about 5 to 22 kilometers offshore in water depths that range from about 20 to 30 meters. The MMS has estimated that placer deposits of gold in the proposed lease-sale area for a mean case could be 530,000 troy ounces. It is projected under the mean case that one dredge would be utilized for mining. About 60 acres per year would be dredged for a period of 14 years, with total dredging to include about 800 acres.

c. State Offshore Mining Program

Two areas along the northern shore of Norton Sound have valid mining leases--the area adjacent to the city of Nome and a small area off the coast near Bluff, about 85 kilometers east of Nome. Permits have been applied for along much of the coast within 50 kilometers to the east and west of Nome. These permits have been pending for several years. As a result of the success of the current mining operation off the coast of Nome, the State may take action on these permits in the near future.

Western Gold Exploration and Mining Co., Limited Partnership (WestGold) is mining for gold on 8,802 hectares (21,750 acres) of offshore leases that extend from about 1.6 kilometers east of Nome to about 16 kilometers west of Nome. The leases extend approximately 4 kilometers offshore. WestGold uses the *Bima*, the largest bucketline offshore-mining vessel currently active. Minimum digging depth is 9 meters; maximum digging depth is 45 meters.

The dredge footprint for the 1987 season covered an area of approximately 22 hectares (53.83 acres). The current offshore-mining operation uses no beneficiation chemicals and yet appears to be exceeding EPA National Pollutant Discharge Elimination System (NPDES) limitations for two trace metals (mercury and nickel), and turbidity in the water column. Data from compliance monitoring by industry indicate that turbidity standards frequently are exceeded at the edge of the 500-meter mixing zone. Ambient concentrations of mercury off the coast of Nome already exceed the EPA chronic marine criterion.

The length of the operating season is anticipated to be 160 days long. It is assumed that WestGold will continue to use the *Bima* on the leases off the coast of Nome and that a shallow-water dredge will be added by 1990.

Pending the results from the smaller shallow-water dredge, it is assumed that lessees holding the leases off the coast of Bluff also would begin to operate a smaller shallow-water dredge--the lease is only 518 hectares (1,280 acres) and water depth is less that 20 meters. During each drilling season, the two smaller dredges (the one operated by WestGold and the other by the lessees off Bluff) would dredge less than the 25 hectares (60 acres) assumed for the *Bima*. The use of mercury during these operations is uncertain. The *Bima* has successfully mined gold without using mercury. However, the State has no categorical exclusion on the use of mercury offshore. Previous operations off the coast near Bluff have been unsuccessful.

D. Cumulative Impacts on Migratory Species

1. Marine Mammals

a. Threatened or Endangered Cetaceans

(1) Bowhead Whale

The western arctic stock of bowhead whales is currently estimated to number about 7,800 individuals (Zeh, Reilly, and Sonntag, 1988). This estimate is considerably larger than the estimated number of bowhead whales that remained at the close of the commercial whaling period (greater than or equal to 1,000 animals) at the turn of the century. There have been no clear trends in terms of population growth in recent years. Population estimates have risen, although the major increases in these estimates are more likely due to better censusing techniques than to a rapidly increasing population. The current estimated population may be about 40 percent of the historic population level prior to commercial exploitation (based upon numbers cited by Braham (1984b)).

Some effects on bowhead whales may occur from previously held State and Federal offshore lease sales. Generally, bowhead whales remain far enough offshore to be found mainly in Federal waters; however, in some areas (e.g., the Beaufort Sea southeast and north of Kaktovik and near Point Barrow) the whales do come close enough inshore to be present in State waters. If exploration, development and production activities occur on leases from State Sales 52 and 55 and future State sales scheduled for the Beaufort (see section IV.C.), noise impacts on bowhead whales may occur as described in section IV.B. These impacts could result from avoidance of vessels, seismic surveys, dredging, drilling, drillships, and production operations that occur within several kilometers of the whales. Bowheads may react briefly by diving in response to low-flying helicopters. However, it is unlikely that there would be any major changes in the overall fall migration route.

Should an oil spill occur, impacts on bowheads could include those discussed in section IV.B., including inhalation of hydrocarbon vapors, a loss of prey organisms, ingestion of spilled oil or oil-contaminated prey, baleen fouling with a reduction in feeding efficiency for up to a couple of days, and skin and/or sensory-organ damage.

Bowhead whales could experience similar impacts from exploratory operations which result from past Federal OCS oil and gas lease sales. It is likely that in future years some additional exploration will take place on previously-leased Federal tracts in the Beaufort Sea. If past experience is used to predict future trends, then for about the next 5 years, fall-migrating bowheads may be exposed to an average of one to two exploratory operations per year. Bowheads that approach these sites would be expected to react as previously described, making minor deflections in their individual swimming paths within the migration corridor to avoid drillsites. Noise from drilling operations is expected to ensonify only a portion of the bowhead-migration corridor and affect a minor portion of the bowhead population. The width and location of the overall fall bowhead whale migration corridor is expected to remain virtually the same.

It is expected that there would be very few impacts on bowhead whales during their fall migration through the Chukchi and northern Bering Seas, and on their wintering grounds in the Bering Sea. Currently, there are no plans for future oil and gas exploration activities in the Navarin Basin on Sale 83 leases. Based upon past operations, exploratory drilling would take place most likely during the open-water season when bowheads are not present in the area.

On their summer feeding grounds in the Canadian Beaufort Sea, the whales may be subject to some disturbance from offshore oil and gas exploration, development and production. Industry interest, to date, has centered around the Mackenzie Delta and offshore of the Tuktoyaktuk Peninsula (see section IV.C.), which comprise a minor portion of the bowhead's summer range. Possible disturbance to bowhead whales from helicopters, vessels, seismic surveys, and drilling would be as previously described. Bowhead whales would be exposed to the risk of oil spills from exploration, development and production, and transportation of oil from the Canadian Beaufort Sea. Oil-spill impacts on the bowhead whales would be as previously described.

A major non-OCS impacting agent on the bowhead whale is the annual subsistence harvest by Alaska natives. Bowheads are taken in the northern Bering Sea and in the Chukchi Sea on their spring migration and in the Beaufort Sea on their fall migration. A quota of 44 strikes or 41 whales landed has been authorized by the International Whaling Commission for 1989. This level of harvest was allowed under the supposition that it would still allow for slow growth in the bowhead population. It was assumed that in future years the bowhead whale population will continue to be monitored, and that harvest quotas will be set in order to maintain a healthy bowhead population level.

Whenever vessels are nearby, whales would likely try to avoid being closely approached by motorized hunting boats; however, once the whales migrate out of the Beaufort Sea, there would probably be few whales interacting with hunters during the fall season, and none during the winter. As the bowheads migrate northward through the northern Bering, Chukchi, and Alaskan Beaufort Seas during the spring, they are subject to being taken by subsistence whalers. A few whales also may be approached by nativehhunting seals and walrus. These whales would likely attempt to avoid being closely approached.

Noise impacts could be expected from the oil and gas activities associated with this and future 5-year programs within the bowhead whale's U.S. range. Noise-producing activities that could interact with fall migrating bowheads would include aircraft traffic, icebreaker or other vessel traffic, geophysical-seismic surveys, artificial-island construction, drilling operations, pipeline construction, and production. Impacts

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of these activities on migrating bowheads, for the most part, have been described previously and bowhead responses could be termed localized avoidance.

Bowheads observed in the presence of drilling operations on their summering grounds in the Canadian Beaufort Sea and during their fall migration through the Alaskan Beaufort Sea exhibited little behavioral responses to these exploratory activities (Richardson, Wells, and Wursig, 1985; Davis, 1987). There was evidence that bowheads avoided close approach (within 10 km) to a drilling operation in the Alaskan Beaufort Sea; however, there was no evidence that the drilling operation acted as a barrier to migration, that migrating whales were significantly delayed while diverting around the drilling operation, or that the time and energy taken to divert around the drilling operation was in any way significant to the well-being or annual energy budget of individual bowheads (Davis, 1987). Bowheads would attempt to avoid any vessel which approaches within several kilometers. Bowhead react to dredge noise and drilling noise similarly.

Stationary sources of offshore noise seem less disruptive to bowhead whales than moving sound sources. Consequently, pipeline construction and production platform noise are probably less bothersome to bowheads than vessel operations. Since there are no production platforms located offshore within the range of the bowhead whale, bowhead behavior has not been observed in the presence of platform noise. A study evaluating the impacts of production noise on bowhead whales has been funded by MMS and is currently underway. Gray whales have demonstrated that they react to noise sources in a generally similar fashion as bowheads. If migrating bowheads react to production noise in the same manner as migrating gray whales off the California coast (Malme et al., 1984), their response to production-platform noise would be much less than their response to drillship noise. As a result, it is expected that bowheads would respond to noise from production platforms by slightly altering their migration speed and swimming direction to avoid approaching these platforms closely (perhaps within a few kilometers).

It appears that exploratory activities would continue within the range of the bowhead whale for at least the next 10 to 15 years, and production would continue for about 40 years. Bowheads may encounter from one to several exploratory operations or production platforms along their fall migration route through the Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas. Bowheads would likely make small changes in swimming speed and direction to avoid closely approaching these operations.

Some minor disturbance to bowhead whales on their fall migration might occur in the vicinities of Point Barrow and Point Belcher. Support traffic (helicopters and vessels) would likely travel between Barrow and any exploration units or production platforms in the planning area. Bowheads would dive quickly if helicopters passed low overhead, and they would seek to avoid close approach by vessels. Most activities would occur during the approximate 10-year period of exploration and development. Once the production platforms and pipelines are in place, the whales would have relatively few noise sources to avoid.

In the Norton and Navarin Basin Planning Areas, if future exploration is confined to the open-water period as it has been in the past, there would be no OCS impacts on bowhead whales since bowheads are not present during the open-water period. During production and if exploration does occur during the fall-spring period when bowheads may be present, impacts on bowhead whales would entail local avoidance, as described previously. Impacts to bowhead whales on their spring migration through the Norton and Navarin Basins would be similar to those previously described for the fall migration.

Concerns have been raised in regard to the impacts of noise from OCS operations being present in the spring lead system and the potential for this noise to delay or block the bowhead spring migration. Principal sources of OCS-related noise during the spring could include bottom-founded drilling units and production platforms. To date, there have been no drilling or production operations in the vicinity of the spring lead system during the bowhead migration.

However, based on noise conditions in the lead system and whale behavior in general in the presence of exploration units and production platforms, it can be projected how bowheads might react to exploration and production noise in or near the lead system. The following information is summarized from pages IV-B-80 through IV-B-82 of the Chukchi Sea Oil & Gas Lease Sale 109 (DOI, MMS, 1987) which is hereby incorporated by reference. One factor to consider is that exploration units and production platforms are stationary, whereas the lead system is not. An exploratory platform present within or near a lead one day may be well outside the lead the next day; therefore, whether it is an obstacle would vary.

High ambient noise levels have been measured at the boundary between open water and pack ice; consequently, ambient noise could be high in the area of the spring lead. If this is the case, ambient noise may mask distant industry noise making it less audible and probably less disturbing to the bowheads. Gray whales, which appear to react to noise disturbance at levels fairly similar to bowheads, show little avoidance of production- or drilling-platform noise. Experimental evidence using playback noise indicated that the point at which 50 percent of migrating gray whales would avoid platform noise was 56 meters for production platforms and 40 meters for drilling platforms (Malme et al., 1984). Sightings of migrating gray whales immediately adjacent to production platforms off the California coast seem to support this experimental evidence. Consequently, if bowheads react to platforms as do gray whales, there should be little avoidance of platforms or drilling units located in or near the spring lead system, and adverse impacts on the migration should be minimal.

Cumulative impacts on bowhead whales, while on their summering range in the Canadian Beaufort Sea, are expected to include local avoidance of offshore oil and gas activities in the Mackenzie Delta. Impacts of these activities on bowhead whales in Canadian waters are expected to be similar to those impacts previously described for bowheads during their fall migration through the Alaskan Beaufort Sea.

The total number of oil spills greater than or equal to 1,000 barrels assumed to occur for planning areas through which bowhead whales migrate are as follows: Beaufort Sea, 3; Chuckchi Sea, 7; Norton Basin, 2; Navarin Basin, 13 (see Table IV.B.4-2).

In the event of an oil spill during the fall bowhead migration through the Beaufort and Chukchi Seas, impacts as previously described in section IV.B. could occur. These may include inhalation of hydrocarbon vapors, irritation of eyes and sensitive skin tissue, temporary fouling of baleen, ingestion of some oil or oil-contaminated prey, and a possible localized reduction in food resources. These impacts would generally be minor and transient unless whales were confined to an area of freshly spilled oil. The fall bowhead migration occurs over a 6-to 8-week period. Consequently, it is likely that only a small percentage of the bowhead population would be exposed to fresh or lightly weathered oil, and few whales, if any, would be expected to be killed or seriously injured by an oil spill.

After bowheads move westward past Point Barrow, they tend to fan out and cross the Chukchi Sea in a broad front. Consequently, this dispersion also reduces the risk of many whales contacting a fresh oil spill. Of course, if the oil spill occurred over a prolonged period of time, more individuals could be contacted. The probability of an oil spill adversely affecting fall-migrating bowheads in the Hope Basin is very low, as most bowheads appear to migrate south within Soviet waters along the coast of the Chukchi Peninsula.

Bowheads would probably be migrating through the Norton Basin Planning Area at the time of rapid ice formation. If oil is spilled during the fall bowhead migration through the area, impacts on bowheads may be similar to those which might occur if oil were spilled into a lead system. A discussion of such impacts is contained on pages IV-B-78 through IV-B-82 of the Chukchi Sea Oil & Gas Lease Sale 109 FEIS (DOI, MMS, 1987).

The presence of ice could restrict the spread of the oil. Agitation of ice particles in combination with oil could initially increase oil dispersion into the water column; however, it would also result in a more rapid formation of a water-in-oil emulsification. Grease ice (newly formed ice) and spilled oil would be blown downwind and would accumulate in a band along the downwind edge of open leads or ice floes. When the lead closes or ice floes are blown together, the accumulated grease ice and oil would be pushed onto the adjacent ice. It is unlikely that oil would completely cover the surface of the water except in cracks and small pools sheltered from the wind.

Harmful concentrations of toxic vapors would be carried away from any leads by the wind, and most volatile compounds would be lost within 24 to 48 hours of weathering at the surface. Oil spilled under winter ice would pool and freeze to the underside of the ice. First-year arctic ice--the most prevalent type in the area-can store up to 150,000 to 300,000 barrels of oil per square kilometer in under-ice relief. Consequently, oil spilled in heavy ice cover would not to spread appreciably under the ice before being frozen into the ice. The spilled oil would then move as part of the pack ice. The oil would either melt out at the southern ice edge as the pack retreated or would migrate through brine channels and pool on top of the ice as spring melting begins.

Spilled oil might contact migrating whales as they surface to breathe. Contact with oil would be brief unless the whales stopped to feed in the area. Impacts would generally be similar to those previously

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described including baleen fouling, inhalation of toxic vapors, ingestion of oil or oil-contaminated prey, and irritation of skin or sensitive tissues. Bowheads may migrate through an oil-spill area without actually contacting oil since, as mentioned earlier, the oil would accumulate along the downwind edge of any open-water areas. On occasion, bowheads have been observed continually returning to the same small area of open water, presumably because there was not more readily available open water where they could surface. If a substantial quantity of fresh crude oil or an aromatic refined petroleum product were spilled into such an area of open water, it is possible that the animals trapped there could die or suffer pulmonary distress from the inhalation of toxic vapors. However, this is expected to be a very rare case that would only affect a low number of whales.

Bowhead whales would be present in the Navarin Basin Planning Area during the winter months so that any spill occurring when bowheads are present would likely be under pack-ice or broken-ice conditions. Oil-spill occurrence impacts on bowhead whales in the Navarin Basin would be as previously discussed for the Norton Basin. Areal extent of oil spills would be limited by the ice. Bowheads appear to be widely scattered along the ice front on their wintering grounds in the Navarin Basin. As a result of this dispersion, only a few whales would likely be exposed to a fresh spill and could be killed or seriously injured by oil spills.

Impacts of oil spills on spring-migrating bowheads through the Norton Basin, Hope Basin, Chukchi Sea, and Beaufort Sea Planning Areas would be as described under the fall migration through the Norton Basin. Concerns have been voiced regarding oil spill impacts on spring-migrating bowheads since the migration appears to be closely linked to the narrow lead system which develops along the Alaskan coast of the Chukchi Sea. As was previously mentioned, if bowheads were confined to a small open-water pond within the lead system and prevented from migrating further due to heavy ice conditions, and if oil were spilled into this pond, it is possible that the whales trapped there could die or suffer pulmonary distress from the inhalation of toxic vapors. However, this would rarely occurr and would affect a low number of individuals.

Should a large oil spill occur which covers a substantial stretch of a major spring lead used by migrating bowheads, a majority of the spring bowhead migration might be delayed or temporarily blocked. Bowheads would probably not migrate through the pack-ice zone to avoid an oil spill blocking a lead unless the pack-ice zone had sufficient cracks or small ponds that the bowheads could use for respiration. If a large oil spill were to occur and inundate a section of the major spring lead, it could affect a substantial portion of the bowhead population; but unless the oil spill were prolonged, its impacts would likely be short-lived. Within several hours to several days after cessation of the oil spill, the oil should have accumulated along the downwind or downcurrent edge of the lead and should no longer pose an impediment to the migration. Such a short-term delay in the migration should not result in significant impacts on the population, since there is considerable natural variability in the migration due to ice conditions. A substantial number of bowheads could contact oil since individuals, driven by the migratory urge, might attempt to find a safe passage through the oil. Some of these individuals might succumb to toxic vapors if the oil spill were very fresh. On the other hand, it has been shown that bowheads are quite adept at migrating beneath thin ice (George et al., 1989); therefore, it could be that an oil-contaminated lead may not be a significant obstacle to the bowhead migration as they may migrate under the ice around the area of contamination.

Multiple oil spills occurring within the range of the bowhead whale within a single year do not appear to result in impacts significantly greater than those that would occur if the same number of oil spills were spaced over several years. Bowhead whales are well dispersed on their summering grounds and also appear to be scattered on their wintering grounds. Consequently, the most critical time of year and area in terms of an oil spill occurring would likely be along the spring lead system where many whales pass within a short period of time and their ability to avoid an oil spill may be limited by heavy ice cover.

In addition, calving appears to peak during late winter and early spring, about the time of the northward migration, so a number of young calves may be present and more susceptible to adverse impacts from oil spills. Multiple oil spills occurring along the spring lead system could result in oil contacting many individuals; however, it is unlikely that serious impacts would result unless individual whales were compelled to remain within an area into which fresh or relatively fresh oil was spilled. The chances of this occurring are very low, and the chances of such an event harming a large number of individuals appear to be virtually nil.

When one combines the impacts from State oil and gas lease sales, previous Federal lease sales, Canadian offshore oil and gas activities, native subsistence hunting, and the 5-year programs, a clearer picture of cumulative impacts on bowhead whales can be seen. It should be noted again that except for limited areas bowheads do not migrate through areas offered in the State lease sales, and impacts are expected to be low. Past Federal lease sales have not resulted in any oil or gas production, and future planned activities on these leases appear limited at this time. Consequently, impacts appear to be low.

Activities in the Canadian Beaufort Sea have resulted in a number of oil and gas discoveries, and production could be forthcoming. However, the area of oil and gas interest occupies a small portion of the bowhead whale summer range, and any impacts of this development are likely to be low.

Subsistence whaling will continue to account for some harvest of bowhead whales. However, the bowhead population will likely be monitored in the future, and harvest quotas will be set to avoid depleting the population.

The current and future 5-year programs may result in exploration and production activities that will produce underwater noise. Behavioral studies have suggested that bowheads habituate to noise from distant ongoing drilling, dredging, or seismic operations (Richardson et al., 1985a, b), but there is still some apparent localized avoidance (Davis, 1987). There is insufficient evidence to indicate whether or not industrial activity in an area for a number of years would adversely impact bowhead use of that area (Richardson et al., 1985), and there has been no documented evidence that noise from OCS operations would serve as a barrier to migration.

CONCLUSION: It is expected that overall cumulative impacts to the bowhead whale population would be low.

(2) Gray Whale

The gray whale is by far the most abundant of the endangered cetaceans in the Alaska and Pacific Regions. In 1937, the International Agreement for the Regulation of Whaling gave protection to the gray whale from hunting by a few nations; in 1946, Japan and U.S.S.R. joined 15 other nations in signing the International Convention for the Regulation of Whaling, which restricted the harvesting of gray whales. Since 1951, all nations operating in the North Pacific have agreed to the provisions which protect gray whales (Reeves, 1984).

Population estimates of gray whales vary since some censuses have been taken from shore and some have been taken from aerial surveys. By all estimates, it appears that the current population of gray whales is between 13,450 and 19,000 animals (Braham, 1984). This level is believed to be at or above its pre-commercial whaling population size. The population has increased steadily (at an estimated 2.5% rate from 1967 to 1980) since it was given protection from overharvesting in the 1940's (Reilly, 1983).

Currently, the major impacts affecting this species are the result of noise from vessels and OCS activities, entanglement in gill nets, and exposure to oil spills. These potential impacts exist throughout the gray whale's range (see Section III.A.1.b. for migration range of the gray whales).

Gray whales have been found to respond to noise from vessels of any size. A reaction was generally recorded when the boat was within 4 km (2.5 mi); whereas avoidance was recorded when a boat approached within 2 km (1 mi) of a gray whale. Gray whales are especially sensitive to vessel traffic in the calving lagoons (Gard, 1974). Currently, three of the five major calving lagoons are designated as National Refuges by the Mexican Government, and vessel traffic is restricted. It is expected that these lagoons would continue to be protected in the future.

Wolman and Rice (1979) hypothesize that increased vessel traffic off southern California might be causing greater numbers of whales to migrate further offshore. However, they also pointed out that little quantitative data exist to support this assumption, and earlier investigators may have simply overlooked the importance of offshore routes. Therefore, there is no evidence that increased vessel traffic has resulted in any adverse impacts, including population decline.

In general, the impacts of noise from existing oil and gas activities on gray whales have been analyzed in detail in the FEIS (Section IV.A., page IV.A-84) and seismic noise on gray whales in DOI, MMS (1983). These studies indicate gray whales generally tolerate noises in ranges of 6-8 km (3.7-5 mi) from the source, but show avoidance behaviors when the source is less than 5 km (3 mi) away.

Noise caused by geophysical surveys is potentially the most disruptive of OCS-related noises because it is not the chronic, routine noise from a stationary source to which wildlife generally habituate. Miles (1984) reported that 430,000 miles of survey lines were conducted off the Pacific Coast between 1964-1983 with the number of miles of line increasing steadily per year from 2,000 line-miles in 1964 to 64,000 line-miles in 1983. Approximately half of these surveys were conducted during the whale migration; yet, the number of gray whales has steadily increased since 1937. Over the last decade and a half, during which geophysical survey activities have increased by 5 percent, the whale population has continued to grow at a rate of about 2.5 percent/year. Therefore, it appears that, at least at the current level, geophysical operations have had no overall harmful impact on the population.

An unknown number of whales drown after becoming entangled in gill nets each year. Gillnetting was the known cause of death for 1 of 8 gray whales which were stranded in California in 1983, and for 4 of 21 which were stranded in 1984 (Seagers et al., 1986). Mortality caused by gillnetting entanglement is expected to continue, but may not increase. This mortality is expected to result in changes in the abundance of the population for less than 1 to 3 years, and therefore, by definition is considered a low impact.

Oil spill impacts on endangered cetaceans are described in the FEIS (Section IV.A.4.c.5). The most serious potential impact of an oil spill on a whale would occur on the summer feeding grounds or winter calving grounds, based on the criticalness of these areas in terms of the whale's life history. Since tanker routes are well offshore from the gray whale calving grounds in Baja, Mexico, the chance of an oil spill impacting the calving lagoons is unlikely. Since there is currently no tankering of oil north of the Aleutian Island chain, there is no chance of an oil spill on the gray whale's major feeding grounds in the southern Chukchi and northern Bering Seas. Therefore, the most likely time a gray whale would come in contact with spilled oil is during its migration. Since whales have completed successful migrations through the Santa Barbara oil spill and have managed to negotiate through natural oil seeps (which leaks some 100 barrels/day [Wilson et al., 1974]) in the Santa Barbara Channel twice every year, impacts of an oil spill on migrating whales are estimated to result be sublethal.

Collectively, these existing impacting agents do not appear to have an adverse impact on the whale populations rate of growth (Reilly, 1983; Miles, 1984). Reilly (1984) predicts that the population will continue to rise (even with an annual take of 180 animals) and eventually achieve stability in 150 years.

In summary, the existing impact agents are expected to continue to have a low impact on gray whales for the next 35 years.

The activities associated with the current and future 5-year programs that may impact gray whales include geophysical surveys, the drilling of exploratory and development or production wells, vessel traffic from supply and crew boat bases to drilling rigs or platforms, and helicopter traffic. The additive impacts of these activities, combined with other proposed and existing projects and activities, are expected to increase the amount of noise and disturbance on gray whales in the Alaska and Pacific Regions. These incremental additions would probably be disruptive, especially geophysical activities near Unimak Pass (in the southern portion of the St. George Basin Planning Area). A large proportion of the population migrates through Unimak Pass. (A situation could possibly exist which would lead to a temporary disruption of migration [see DOI, MMS, 1983, pages 29-31].) However, the additional activity is not expected to increase the existing level of impact to this species above low.

The cumulative risk of oil spills in the Bering and Chukchi Seas is significant (30 oil spills (see Table IV.B.4-2) are assumed from all oil and gas activities in these planning areas). Although gray whales are found from Bristol Bay to Pt. Barrow during May to November, many (as much as 3-5% of the total population) tend to concentrate in the northcentral Bering Sea between St. Lawrence Island and the Bering Strait (in the Norton Basin Planning Area) to feed in the summer. This prime feeding area covers about 35,000-40,000 km^2 (13,500-15,400 mi2). The estimated mean number of oil spills in this area is only two (2) for the life of the project (i.e., 35-40 years). The adjacent Navarin Basin Planning Area has an estimated mean number of 13 oil spills. A very large oil spill (100,000 bbls) could cover 2,850 km^2 (1100 mi^2), or about 8 percent of the feeding area. Assuming two oil spills (one in the Navarin Basin and one in the Norton Basin) any time in the same year (since a oil spill in winter would permeate the ice and be released in the spring), as much as 6 percent of this prime feeding area for 3-5 percent of the population could be impacted due to displacement or decreased food supply. But based on studies by Geraci and St. Aubin (1981, 1983), and if only a small area of prime feeding ground was contaminated by an oil spill, the direct and indirect (eg., loss of prey) impacts of an oil spill would not be apparent immediately. However, full recovery should occur within 1 to 3 years.

CONCLUSION: The overall cumulative impacts to gray whales from OCS and non-OCS activities in the Alaska and Pacific Regions are expected to be low.

(3) Fin and Humpback Whales

The North Pacific fin whale population is estimated to have ranged from 42,000 to 45,000 before whaling began. Due to their speed and the fact that they sank when killed, few fin whales were taken prior to the introduction of modern whaling techniques at the start of the 20th century. By the time fin whaling ended in the North Pacific in 1976, the population had been reduced to 14,620 to 18,630 individuals (Ohsumi and Wada, 1974). Sighting data on fin whales from the North Pacific have been limited, but it appears that the population remains at less than half its pre-exploitation level (Mizroch, Rice, and Breiwick, 1984b).

The pre-1905 humpback population of the North Pacific was probably about 15,000. From 1905 to 1965, about 28,000 humpbacks were taken by whalers in the North Pacific, reducing the population to about 1,000 (Rice, 1978b). The current population is estimated at between 1,200 and 2,100 individuals and may be slowly increasing (Rice, 1978b; Darling and Morowitz, 1986).

The ranges of fin and humpback whales in the North Pacific widely overlap. Both species have been associated with similar water depths in areas of high benthic relief (Brueggeman et al., 1988). Both whales are rorquals and employ similar feeding strategies. Because of these many similarities and the fact that OCS activities would probably have similar impacts on these species, we have decided to group these species together in our analysis of impacts.

The summering grounds of fin and humpback whales are found on waters over the continental shelf mainly from the central and southern Bering Sea, through the Gulf of Alaska, and along the coast of central California. Some of the significant activities that could impact these species include commercial and subsistence fishing, tankering and other shipping, and OCS activities.

Fishing is a large industry with major fisheries for salmon, herring, shellfish, and groundfish. Fishing activity, both commercial and subsistence, probably has some impact on fin and humpback whales through noise disturbance caused by fishing vessels. The impacts of individual vessels are probably quite low; however, the combined impacts of several vessels in an area can produce a zone of high sound level comparable to that produced by a much larger vessel, and may cause whales to move several kilometers to avoid the noise. Another potential impact that may occur, but has not been proven, is competition between fishermen and whales for species such as herring and pollock used by whales as a food resource.

Tankering and shipping could impact whales in that the whales would likely attempt to avoid any ships that approach them closely. Also, the tankering of crude oil or refined products would present the possibility of an oil spill. Oil tankering occurs in most Alaska OCS Planning Areas within the range of these species. Tankers transporting North Slope crude depart the Port of Valdez carrying approximately 2 million barrels per day for markets on the Pacific coast, Gulf of Mexico, Hawaii, and Nikiski refinery in Cook Inlet, Alaska. These tankers traverse the Gulf of Alaska Planning Area and all of the Pacific OCS Region Planning Areas. Approximately 11 oil spills are projected in these planning areas as a result of North Slope crude oil tankering. If an oil spill were to occur, the impacts could vary depending upon where the oil spill occurs and the time of year. Much of the tanker routes are far offshore, and any oil spills occurring in these areas would be unlikely to impact fin or humpback whales.

Oil spills occurring during the summer in Prince William Sound, near the Alaska coastline, or in the Farallon Basin could result in fin or humpback whales being contacted by oil. Whales that contact oil could experience impacts similar to those described for the bowhead whale including inhalation of hydrocarbon vapors, localized reduction in prey organisms, ingestion of spilled oil or oil-contaminated prey, baleen fouling with a transient reduction in feeding efficiency, and possible skin and/or sensory organ damage. However, it may be that even if individuals were contacted by spilled oil, impacts may be negligible since Goodale et al. (1981) reported that both fin and humpbacks were observed feeding among the oil spilled by the *Regal Sword* without any apparent adverse impacts.

Some areas such as Unimak Pass have a high level of shipping traffic, and the noise from these vessels would likely cause fin and humpback whales to evade the vessels would approach the whales closely. Humpbacks whales that winter near the Hawaiian Islands are exposed to a high degree of noise and traffic

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associated with jet skiing, parasailing, and whale watching. There has not been a detectable decline in the wintering population; however, the whales do appear to be moving farther offshore away from the most congested waters (Salden, 1988). This behavior may be detrimental to reproduction or calf rearing since cow/calf pods prefer nearshore shallow waters (Smultea, 1989).

Currently, no further exploration is scheduled within past lease sale areas in Alaska within the range of fin and humpback whales; however, a number of previous lease sales have occurred within the Bering Sea and Gulf of Alaska, and there are active leases on which exploration could occur. Off the California coast, it appears that OCS oil and gas activities are generally not impacting fin and humpback whales on their summer ranges, but there is considerable OCS activity along their migration corridor. Oil and gas activities have the potential to affect these species through noise disturbance or oil spills.

Noise from OCS operations would likely cause fin and humpback whales to avoid the immediate area of the activities; however, the area of avoidance is likely to be rather small. Malme et al. (1985) could find no clear evidence of avoidance of sound-playback sources from several types of industrial activity by feeding humpback whales in southeast Alaska. They also concluded that the avoidance criteria derived for the gray whale could be applied to feeding humpback whales--500 m for a drilling platform, 22 m for a helicopter, 1 km for a drillship, and 1 to 2 km for seismic surveys. The impacts of OCS noise on fin whales has not been studied since this species is not often present in areas undergoing OCS activity. There is no reason to believe that this species would react much differently to noise than the other whale species previously discussed. Ljungblad et al. (1982) observed fin whales about 36 km from a seismic boat behaving normally in the presence of seismic noise (estimated received level at the whales was 150 dB/1 uPa). Consequently, it appears that fin whales would display minor avoidance of OCS activities. The avoidance displayed by fin and humpback whales would probably be limited to the migratory season since neither species is expected to winter in significant numbers in areas undergoing OCS exploration and production.

The estimated mean number of oil spills greater than or equal to 1,000 barrels for the remaining recoverable reserves in the Southern California Planning Area is 3. Impacts of oil spills on fin and humpback whales would be as previously described.

Noise impacts on these species as a result of activities associated with current and future the 5-year programs would be somewhat higher than under present conditions. As previously described, it is likely that fin and humpback whales would display local avoidance of seismic surveys, drilling, production platforms, and vessel and helicopter traffic. The fin whale population appears to be fairly dispersed, and their migration routes and wintering areas appear to be well offshore (mostly beyond the limits of OCS activity). Consequently, it does not appear that the increase in noise from oil and gas activities associated with the current and future 5-year programs will significantly affect the fin whale population.

As described earlier, principal humpback summering and wintering areas appear to be outside areas of OCS activities, and migrating individuals are likely to be present in the area of OCS activities for only a short time. Also, the humpback migration corridor for those individuals that migrate along the Pacific coast does not appear to occur nearly as close to the coast as the gray whale migration. Consequently, it does not appear that the slight increase in noise from oil and gas activities associated with the 5-year programs will significantly affect the humpback whale population.

The impacts on fin and humpback whales with the addition of the current and future 5-year programs are expected to be qualitatively similar but quantitatively slightly higher than the existing conditions. Within waters on the Alaska OCS, 30 oil spills equal to or greater than 1,000 barrels are assumed to occur within the primary range of these species over the next 40 years. About 20 oil spills are assumed to occur in the next 35 years within the species' range in the Pacific OCS Region. Oil spill impacts would be as previously described.

If some individuals were to encounter more than one spill in a given year, it is conceivable that some old, weakened, or young whales among these individuals may die; however, due to the generally dispersed nature of the populations, it is unlikely that many individuals would contact multiple oil spills or that more than a few individuals would be seriously injured. One factor that bodes well for the humpback whale is the fact that their larger summer concentrations appear to occur in areas unlikely to have OCS development--the inland waters of Southeast Alaska and the Farallon Basin.

Within Alaskan waters, most humpbacks appear to migrate south toward wintering grounds off Hawaii. Only a few whales (from Southeast Alaska) appear to migrate along the Pacific coast toward wintering grounds off Mexico. Consequently, most of the population would be exposed to potential oil spills from a single planning area (Gulf of Alaska whales) or a few planning areas (Bering Sea whales), and only a minor portion of the population would be expected to be exposed to oil spill risk from activities within both the Alaska and Pacific OCS Regions.

CONCLUSION: The cumulative impacts to the fin and humpback whale are expected to be very low.

(4) Right, Blue, Sei, and Sperm Whales

This group of whales is quite diverse taxonomically and in terms of habitat utilization. The unifying factor is that these species are rather uncommon in areas undergoing or proposed for OCS activities.

The North Pacific right whale population is very low. Right whales were hunted nearly to extinction by commercial whalers during the 1800's. The current size of the population is unknown, and no reliable estimate is possible give the limited sighting information; however, sighting records suggest that there are probably only a few hundred individuals remaining (Braham and Rice, 1984). There has been no evidence to indicate that the population has been increasing.

The most recent estimate of the North Pacific blue whale population is 1,530 individuals (Wada, 1977); however, there has been little new information on blue whale abundance since hunting ceased in 1967. There have been numerous sightings in the last several years off Mexico and California, but no useful census data for population assessment. Given the relative scarcity of blue whales based on opportunistic sightings, the low population estimates relative to their initial abundance, and the low intrinsic rate of increase noted for this and other baleen whale populations, there is no evidence, to date, that the blue whale stocks in the North Pacific are recovering (Mizroch, Rice, and Breiwick, 1984).

The pre-exploitation population of sei whales in the North Pacific was estimated at 45,000 whales (Ohsumi and Fukuda, 1975). Catches of sei whales in the North Pacific and Bering Sea rose sharply during the 1960's, and then dropped sharply thereafter. The most recent population estimates have varied between 8,600 individuals (Tillman, 1977) to 37,000 individuals (Ohsumi and Fukuda, 1975). There are no indications of population trends for this species.

The number of sperm whales in the eastern North Pacific stock appears to be fairly high. It is estimated that the number of individuals in the eastern North Pacific population large enough to be commercially exploitable--males aged 11 years and older and females aged 10 and over--is about 274,000 (International Whaling Commission, 1979). This is approximately 88 percent of the estimated population prior to commercial exploitation. There is no information regarding recent trends for this species, and it should be noted that new analyses of population numbers using different data sets and biological parameters may produce much different population estimates (Gosho, Rice, and Breiwick, 1984).

Activities unassociated with this 5-year program and future 5-year programs that could affect these species would include commercial and subsistence fishing, tankering and shipping, and previous OCS lease sales. Fishing could affect these species through noise disturbance associated with fishing vessels and possibly through competition for species utilized by the whales for food. Whales are likely to show little avoidance of individual fishing vessels since they generally do not produce sound at very high levels; however, whales may show greater avoidance of a number of vessels operating in the same general area because the combined sound level from these vessels could be considerably high.

Tankering and shipping could affect these species through noise disturbance and the potential for an oil spill. Impacts of noise disturbance have not been evaluated on these species since they are uncommon in the areas of potential OCS interest, but it is believed that they would react in ways similar to other whale species whose behaviors have been documented in the presence of noise sources. It is likely that these species would avoid any vessels that closely approach them, but their behavior would return to normal shortly after passage of the vessels. For example, blue whales still occupy Monterey Bay, California, despite the fact that vessel traffic there could be described as moderate, and a local stock of blue whales appears to be doing well in the Gulf of St. Lawrence despite being the object of whale watching trips (Mizroch, Rice, and Breiwick, 1984).

Impacts of shipping noise would appear to be greatest in areas where the traffic appears to be concentrated, such as Unimak Pass. The potential oil-spill impacts from tankering operations is more fully described in the previous section on fin and humpback whales. If an oil spill were to occur and whales were contacted, the impacts are expected to be similar to those described for fin and humpback whales, including inhalation of hydrocarbon vapors, localized reduction in prey organisms, ingestion of spilled oil or oil-contaminated prey, baleen fouling with a transient reduction in feeding efficiency, and possible skin and/or sensory organ damage. Even if individuals were contacted by spilled oil, impacts may be negligible since Goodale et al. (1981) reported the probable sighting of right whales feeding among the oil spilled by the tanker *Regal Sword* without any apparent adverse impacts.

Currently in Alaska, no further exploratory operations are scheduled on leases acquired in past lease sales within the range of these species; however, a number of previous lease sales have occurred within the Bering Sea and Gulf of Alaska, and active leases remain on which exploration could occur. Off the California coast, it appears that OCS activities are generally not affecting these species. The sperm whale typically inhabits waters deeper than 200 m, and the blue and sei whales are more pelagic in nature than some of the other whale species; consequently, they most often occur in waters not occupied by OCS activities. Right whales are so scarce it is unlikely that they would interact with OCS activities.

Oil and gas activities have the potential to affect these species through noise disturbance and oil spills. In the event that individuals from these species would be present near OCS activities, it is expected that they would react to the noise as do other whale species, namely displaying localized avoidance of seismic surveys, vessel and helicopter traffic, drilling, and production platforms. The impacts of oil spills on these species would be as previously described.

Noise impacts on these species as a result of activities associated with the current or future 5-year programs would likely be slightly higher than the very low level that exists under present conditions. As previously described, the whales would be expected to avoid the vicinity of OCS activities. However, these species are seldom present in areas of OCS activity so this avoidance is expected to be very minor. Slightly greater impacts on blue whales may be expected if oil and gas activities occur in the Santa Rosa-Cortes Ridge and Tanner-Cortes Banks areas of southern California since blue whales are known to frequent these areas. Localized avoidance of OCS activities could be expected.

Oil spill impacts on these species as a result of activities associated with the 5-year programs are expected to be only slightly higher than the very low level that currently exists. Within waters on the Alaska OCS over the next 40 years, an estimated mean number of about 30 oil spills could occur within the normal range of the right whale and sperm whale, and about 11 oil spills within the range of the blue whale and sei whale. An estimated mean number of 20 oil spills could be estimated to occur in the next 35 years within the species' ranges in the Pacific OCS Region. Oil-spill impacts would be as previously described and would appear to be sublethal.

It is anticipated that tanker oil spills could have greater impacts on blue, sei, and sperm whales since tanker routes in most areas are farther offshore and probably closer to the more pelagic habitats utilized by these species. Given the relative rarity of these species in areas of OCS activity, it is unlikely that any individuals would contact multiple oil spills in a given year.

CONCLUSION: The cumulative impacts to right, blue, sei, and sperm whales are expected to be very low.

b. Nonendangered Cetaceans

(1) Beluga Whale

The major migratory group of beluga whales in Alaskan waters is the Bering Sea population. This population summers in four different areas in U.S. and Canadian waters. Population estimates for these four summering group areas as follows: Bristol Bay 1,000 to 1,500; Norton Sound 1,000 to 2,000; Eastern Chukchi Sea 2,000 to 3,000; and Beaufort Sea 11,500. Bristol Bay is the only area in which surveys have been thorough enough to provide a baseline for evaluating population trends. Declines in abundance have been reported, although it is uncertain whether these represent a shift in distribution or a decline in population size (Hazard, 1988).

Existing impacting agents that may affect beluga whales program would include subsistence harvest, commercial and subsistence fishing, the Red Dog Mine, tankering and vessel traffic, and existing OCS oil and gas activities (see Section IV.C). Harvests and incidental catches have the most clear and direct impacts on beluga whales. The average annual subsistence kill of beluga whales in Alaska and western Canadian waters is about 570. In all areas except perhaps Norton Sound, harvest mortality appears to be

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lower than the estimated gross annual recruitment rate. The current trend is a decline in the number of beluga whales harvested as compared with the early and mid-1900's (Hazard, 1988).

Potential impacts to beluga whales from commercial and subsistence fishing activities would include net entanglement, competition for prey, and possibly disturbance due to vessel noise. Bristol Bay appears to be the primary area where net entanglement poses a problem. Entanglement has apparently increased since the 1950's, and is thought to have resulted from the shift from cotton to nylon nets, an increase in the number of set nets, and an increase in the amount of time gear is in the water (Frost et al., 1983). In 1982, at least 1 of the 6 beluga carcasses found was from a fishing-related death; and in 1983, 39 to 44 percent of the 27 to 31 beluga carcasses found were fishing-related mortalities (Hazard, 1988).

Competition for prey species is more often asserted than proven. During the late 1960's and early 1970's, Bering Sea herring were harvested by Soviet and Japanese offshore trawlers in the winter and by foreign-fleet nearshore fisheries in the spring and summer. Tununak residents claimed these harvests severely reduced herring catches and also attributed a decline in the local presence of beluga whales to this fishery (Pete, pers. commun., cited by Hazard, 1988). The fishery was stopped in 1976, and recently the herring biomass has shown a steady increase, and more belugas were sighted during 1985 than during previous years (Whitmore, pers. commun., cited by Hazard, 1988).

The potential for noise disturbance by fishing vessels may vary from area to area. Residents of coastal communities suggest that vessel traffic from increased commercial fishing and other activities may have affected the distribution of the whales. Outboard motors, especially when operated at high speed, have the greatest potential for interfering with beluga communication and echolocation. In an experiment, belugas in Nushagak Bay responded more to outboard motors than to inboard-powered vessels or to playbacks of oil drilling sounds, and outboard motor noise seemed to cause aversion at a considerable distance (Stewart et al., 1982). Residents from western and northwestern Alaska coastal communities attribute the reduced numbers of beluga whales in coastal areas to the increase in boat traffic, particularly those powered by outboard motors, and perhaps other noises associated with modernization. However, in Bristol Bay, beluga distribution appears to be determined by prey distribution, tide, bottom topography, and other environmental factors since belugas often approach fishing boats and nets and frequent rivers and other areas of especially active fishing effort (Frost et al., 1983).

Operation of the Red Dog Mine and accompanying port may affect some beluga whales. Transport of ore concentrates from the dock to lighters and from the lighters to ore carriers creates the risk of spillage and accompanying water quality degradation as does the transfer of petroleum products, reagents, and other toxic materials. Belugas migrate through the area in leads during the spring and along the coast in June through August and intermittently in autumn. Noise and activity associated with the operation of the port transfer facility would occur year-round and may displace whales offshore, particularly during the ice-free shipping season from late June to early October (EPA and DOI, 1984). The impacts of this displacement are unknown.

Beluga whales could be affected by OCS oil and gas exploratory operations on previously leased tracts. Impacts could occur from noise or oil spills. Sources of OCS exploration noise that may affect beluga whales would include vessels and seismic surveys, helicopters, dredging, and drilling.

Reactions of beluga whales to mobile noise sources such as vessels may be highly variable depending on the animals' prior exposure to the disturbance source and their need to be in a particular habitat area where they are exposed to the noise and visual presence of the disturbance source. For example, Fraker, Sergeant, and Hoek (1978) reported the startle response and flight of beluga whales from barges and boats traveling through a whale-concentration area. Finley and Davis (1984) reported strong fleeing reactions by beluga whales when icebreakers approached at distances of 35 to 50 km in two documented cases. The whales were displaced or moved over 80 km along the ice edge, or they stopped moving within 20 km when they reached coastal waters. Such strong reaction suggests that these whales may have been "naive" with respect to vessel noise. Monitoring of beluga whale behavior and distribution for the past 10 years in the Mackenzie River Delta estuary (in association with marine traffic supporting Canadian oil and gas activities) has not shown any long-term or permanent displacement from the estuary, despite comparatively high levels of industrial activity (Fraker, 1983). Although beluga whales would likely avoid the immediate vicinity of seismic survey operations, it is unlikely this avoidance would last long after the survey vessel departed the area.

Belugas respond to low-flying aircraft by diving for longer periods, spending less time at the surface, and swimming away. Feeding groups are less prone to disturbance (Kleinenberg et al., 1964). It is unlikely, though, that belugas would be significantly disturbed by helicopters making an occasional single pass overhead.

Beluga whales do not appear to be greatly disturbed by dredging operations as they approached within 1 km of an operating suction dredge (Fraker, 1977a; Fraker et al., 1982). Belugas often approach within a few kilometers of drilling operations on artificial islands (Fraker, 1977a, b; Fraker and Fraker, 1979) and even closer to drilling ships.

In the event of an oil spill occurring and contacting beluga whales, impacts generally similar to those described for the bowhead and other whales could occur including inhalation of hydrocarbon vapors, ingestion of spilled oil or oil-contaminated prey, and damage of skin and/or sensory organs. Vapor concentrations harmful to the whales would likely dissipate within a few hours of the oil weathering at the surface; consequently, unless whales were trapped in the immediate area of a fresh oil spill, it is unlikely that they would be harmed by petroleum vapors.

Belugas feed primarily on fish that are wide ranging and thus unlikely to be affected by oil spills. However, in some areas belugas feed on bottom-dwelling species, and it is conceivable that in shallow areas belugas may incidentally ingest some oil or oil-contaminated prey while feeding on these species. Dolphins have shown the ability to ingest some oil without significant detrimental impacts (Caldwell and Caldwell, 1982), and it is suspected that oil ingestion in small amounts by belugas would not be a significant problem.

Contact with petroleum hydrocarbons can irritate or harm sensitive tissues such as eyes and mucous membranes. No data are available on cetacean-eye sensitivity to oil; however, ringed seals exposed to crude-oil-covered water showed signs of eye irritation within minutes after exposure, but eye conditions resolved after being returned to clean water (Geraci and Smith, 1976). Given the time that beluga whales are likely to be exposed to spilled oil or remain within oiled areas, it is unlikely that significant skin or eye problems would result.

On their summer feeding grounds in the Canadian Beaufort Sea, the whales may be subject to some disturbance from activities associated with offshore oil and gas exploration and development and production. The main area of industry interest to date has centered around the Mackenzie Delta and offshore of the Tuktoyaktuk Peninsula (see section IV.C.). Possible disturbance to beluga whales from helicopters, vessels, seismic surveys, and drilling would be as previously described. Beluga whales would be exposed to the risk of oil spills from exploration, development and production, and transportation of oil from the Canadian Beaufort Sea. Oil spill impacts on the beluga whales would be as previously described.

As a result of the current and future 5-year programs, whales in each of the summering areas are expected to be exposed to noise associated with OCS exploration and development and production. Noise levels are expected to be slightly higher than the very low level that exists currently. Qualitatively, impacts would likely occur as previously described and mainly result in avoidance of the immediate area of the noise source. There are many reports of belugas in the immediate vicinity of Cook Inlet oil platforms. Belugas, including females with calves, pass as close as 10 m to active platforms. McCarty (1981) commented that belugas seem not to be affected by constant noise, but temporarily avoid sudden changes in noise level. The expected noise levels with the current and future 5-year programs would seem to be a slight increase over existing noise levels; however, those noise sources that would exist for the longest time--production platforms--seem to be largely ignored by beluga whales in Cook Inlet. Consequently, it is not expected that noise as a result of the 5-year programs would result in significantly greater impacts than without this alternative.

Impacts of oil spills on beluga whales as a result of the current and future 5-year programs are expected to be somewhat higher than under the present condition. The estimated mean number of spills of 1,000 barrels or greater in the next 40-year period within the range of each of the beluga whale summering groups are as follows: Bristol Bay, 18; Norton Sound, 19; eastern Chukchi Sea, 25; and Beaufort Sea, 29. Not all of these spills would occur while beluga whales are present; in fact, it is likely that less than half of the oil spills would occur while beluga whales are present in the affected planning area. The impacts of an oil spill on beluga whales have been previously discussed. Most often, the impacts of an oil spill in an area occupied by beluga whales would be in nonlethal to the whales. However, the most critical time and location of an oil spill would be in an area where beluga distribution is restricted by ice cover. In this

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case, if belugas were limited to surfacing in a small open-water area and fresh crude oil were spilled into this area, a number of animals could die or suffer pulmonary distress from the inhalation of petroleum vapors. This circumstance could occur within wintering areas in the Bering Sea or along the lead system during the spring migration. This situation is expected to be rather rare since beluga whales would not normally allow themselves to be present in an area in which breathing holes are severely limited. In the event that beluga whales are exposed to multiple oil spills in the same year, particularly during the spring migration, it is conceivable that a number of old, young, weakened, or stressed individuals could die. However, it is expected that multiple oil spills during the same year within beluga wintering areas or the spring lead system would be rare.

CONCLUSION: The cumulative impacts to the beluga whales are expected to be low.

(2) Minke Whale

Although they have a wide distribution, Minke whales are not considered abundant in any part of the North Pacific except Alaska. Little is known of their historic population size, as historically these whales were not actively hunted because of their small size relative to other baleen whales. The information that is available is derived from present day catches from the Okhotsk Sea-West Pacific stocks by Japanese and Korean whalers. Minke whales in the northeastern Pacific are presently protected from whaling. Between 1954 and 1982, 22,746 minke whales were killed in the northwest Pacific. Based on this data and historical catches of minke whales, the size of the West Pacific stock was estimated in 1981 to contain 17,000 to 28,000 animals. The northeast Pacific population may contain similar numbers.

Currently, the major impacts affecting this species are noises from vessels and OCS activities, and oil spills. Minke whales, in all likelihood, respond to noises and spilled oil like other baleen whales. The generic impacts of noise and oil spills on cetaceans are discussed in the FEIS (Section IV.A., pages IV.A-64 to 84).

Nishiwaki and Sasao (1977) suggest that increased ship traffic in Japanese waters disturbed migration routes of minke whales. No similar observation has been made on the northeastern population. Therefore, it is unknown what, if any, impact current or future vessel traffic has or will have on migrating minke whales.

Minke whales that calve in the Southern California Bight are probably the most sensitive to noise and human disturbance due to this critical stage. However, in the humpback whale, a closely related species, there has not been a detectable decline in the population despite the increased noise and traffic associated with jet skiing, parasailing and whale watching expeditions near the calving grounds off Maui, Hawaii (Salden, 1988). Whales, however, are generally moving farther offshore away from congested waters. Therefore, cow/calf pairs may be displaced from preferred habitats by repeated disturbance in the Southern California Bight, but impacts to the population as a whole are expected to be low over next 35 year period.

Impacts from an oil spill would occur to minke whales while they are present at summer feeding grounds and/or the winter calving grounds. Since most baleen whales do little feeding during migration or on the calving grounds, most of their blubber layer is put on during summer feeding. Therefore, the summer feeding grounds are important to allow individuals to build up energy reserves necessary to sustain themselves through a migration cycle. However, since the minke whale's food (mostly euphausiids and copepods crustaceans) has a patchy distribution and a high turnover rate, an oil spill would have to occur during the feeding season, cover a very large area, and be persistent to have anything other than a temporary, local impact on whales. Impacts from an oil spill would be exacerbated if a similar oil spill were to occur during the same migration cycle, while animals were on the calving grounds. While on the calving grounds, cows are already stressed from the long migration, giving birth, and nursing the calf.

The estimated number of oil spills from existing oil and gas activities (see Table IV.B.4-2) is 7 for the Gulf of Alaska and 7 for southern California. Assuming oil spills occur in both the Gulf of Alaska and the Southern California Planning Areas and contact minke whales, these oil spill would have to occur during both critical seasons (i.e., in summer in Alaska, and winter in southern California) to have greater than a sublethal impact on the minke whales. However, if it is assumed that an oil spill occurs independent of season of year and with uniform frequency over the 35-to 40-year period within the planning areas, it is unlikely that an oil spill would occur during both critical periods within a migration season. However, if an oil spill were to occur and contact the minke whale, the population would probably recover within one generation.

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In summary, there is a low probability that an oil spill would contact minke whales at critical times of the year. If oil spills did occur, the impacts on the population do not appear lethal and, thus, would be very low.

The activities associated with the current and future 5-year programs which may impact minke whales include the drilling of exploratory and development-production wells, vessel traffic from supply and crew boat bases to drilling rigs or platforms, and helicopter traffic. The additive impact of these activities, combined with other proposed and existing projects and activities, are expected to increase the amount of noise and disturbance on minke whales in the Alaska and Pacific Region. This incremental addition is not expected to increase the level to this species above the very low impact that is expected from existing activities.

The risk of oil spills from the 5-year programs in the Gulf of Alaska and the Southern California Planning Areas is small when compared to the total estimated mean number of oil spills from all sources (Table IV.B.4-2). However, the increase in the estimated number of oil spills is not expected to increase the level of impact above the very low level of impact that is expected from existing activities.

CONCLUSION: The cumulative impacts from OCS and non-OCS actvities in the Alaska and Pacific Regions within the range of migrating minke whales are expected to be very low.

(3) Harbor Porpoise

Only recently (Gaskin, 1984; Barlow, 1988) has there been a comprehensive survey of harbor porpoises on the Pacific Coast. Since these surveys are the first done for this species, no conclusions can be made as to whether the population is stable or changing.

The most obvious existing impact agent affecting this species is mortality caused by entanglement in gill nets set to catch commercial fish (see Section III.B.2.c.). Gill net mortality in California has been estimated at 300±190 individuals in 1983-84 and 200±50 in 1984-85 (Diamond and Hanan, 1986; Hanan et al., 1986). In California, harbor porpoises are the fourth most frequently stranded animal (behind sea lions, harbor seals, and elephant seals) (Seagers, 1986). This incidental take has been of particular concern to the NMFS because, until recently, little information has been available on the animal's population status as a whole. Consequently, the actual impact of gill net fishing on the population is currently under investigation (DeMaster et al., 1985).

For the purpose of this analysis, it is assumed that the population is approximately 46,000 animals for the Pacific Region (see section III.B.2.c.). With a take of 500 animals (i.e., 300±190, see above) in California by gill netters and assuming a take of 500 in Oregon and Washington, the total assumed take for the Pacific Region could be as high as 1,000/year or 2.2 percent of the total population. The maximum growth rate for phocaenids is probably percent/year (Barlow, 1986, as cited in Reed and Gaskin, 1988). However, assuming the maximum growth rate and taking into consideration current population levels, it is expected that the harbor porpoise population can recover from losses by the next generation (i.e., 4 years). Impacts in Alaska are probably similar to those described above.

The harbor porpoise, primarily a nearshore animal, would be susceptible to nearshore pollution. The sublethal impacts resulting from organic contaminants on cetaceans have only recently been investigated (Reijnders, 1986; Subramanian et al., 1987; Ono, 1987; Tanabe et al., 1988). Some of these investigations suggest that present levels of organic pollutants could cause imbalances in sex hormones and subsequent reproduction abnormalities in cetaceans.

As a nearshore animal, the harbor porpoise has come in contact with human activities/disturbances. This species has probably habituated to these types of disturbances. It may, therefore, be assumed that noise from existing vessels has negligible impacts on the species.

Oil-spill impacts on cetaceans are discussed in the FEIS (Section IV.A.4.c.5). Since these animals frequent bays and harbors (unlike most cetaceans), they could be susceptible to the more toxic impacts of oil spills which may become concentrated in a sheltered bay or harbor. Smith et al. (1983), reported that bottlenose dolphins can detect and actively avoid oil; presumably so could harbor porpoises, thereby reducing their risk of contact. An oil spill would not affect their food, since they feed primarily on schooling fish which have a patchy distribution. Even a large oil spill affecting a given area would only have a local, temporary impact.

In summary, it is not possible to accurately estimate the impact of gill netting or organic pollution on this species because only recently have any pertinent baseline population data become established. Barlow (1988) points out that his estimates of abundance in northern and central California (surveyed in 1984 to 1986) correspond with Dohl et al. (1983) estimates (surveyed in 1980-83) (which may suggest a stable population); however, he adds that their methodologies were different and, therefore, are not directly comparable. However, assuming documented mortality in California is similar throughout the Alaska and Pacific Regions, impacts from gill netting is probably moderate on harbor porpoises. Impacts of existing noise and risk of oil spills on this species are estimated to be negligible.

The only activities associated with the 5-year programs that may impact harbor porpoises is vessel traffic from supply and crew boat bases to and from drilling rigs or platforms. The additive impact of this activity combined with other proposed and existing projects and activities is expected to increase the amount of noise and disturbance on harbor porpoises in the Alaska and Pacific Regions. However, the incremental addition is not expected to increase the level of impact to this species above the current level from existing activities.

CONCLUSION: The cumulative impacts from OCS and non-OCS activities within the Alaska and Pacific Regions are expected to be moderate .

c. Pinnipeds

(1) Northern Fur Seal

The world population of northern fur seals is estimated at 1.2 million (Fowler, 1985a). About 827,000 comprise the Pribilof Islands population, while about 4,000 are associated with San Miguel Island off Santa Barbara, California. A small breeding group also has become established on one of the Aleutian Islands. The Pribilof population has been declining since the 1950's, interrupted by one period of increase; between 1975 and 1981 the rate of decline was estimated at 4-8 percent per year (Fowler, 1985b). Since 1981, the trend has not been statistically significant (York and Kozloff, 1987); however, the northern fur seal has been designated as depleted under the Marine Mammal Protection Act. There has been no commercial harvest of fur seals on the Pribilof Islands since 1984, although a small subsistence harvest has taken place (Zimmerman and Melovidov, 1987).

Although some fur seals are found throughout their range at all times of the year, the majority are found in the North Pacific during winter and spring (December to May) and in the Bering Sea during summer and fall (May through November). Fur seals rarely come ashore except at the rookeries. During summer, they are concentrated over the continental shelf in the vicinity of the Pribilof Islands and southeastward to the eastern Aleutian Islands. Fall migration proceeds through eastern Aleutian passes and follows the edge of the shelf around the Gulf of Alaska and south to offshore wintering areas from British Columbia to California. Spring migration retraces much of this path but many females and young males follow a more direct route from the Pacific northwest across the gulf to Kodiak Island and the eastern Aleutians (Bigg, 1982; Fiscus, 1978).

Activities that could produce adverse impacts include oil and gas development in the Bering Sea, Gulf of Alaska, and California; commercial fishing operations; and subsistence harvests. Certain climatic impacts (e.g., El Nino), altered prey distribution or abundance, or predation also may exert periodic influence. Agreement is lacking on the factor(s) causing the population decline. Decreased carrying capacity of the environment due to overfishing has been suggested, but this is not supported by stable reproductive rates, increased pup survival and weight, and increased fur seal body size. In fact, increased food availability is indicated.

The current small subsistence harvest is not likely to influence the size of the population significantly, but impacts of past commercial harvests, if any, could continue for some time. A decline in the number of fur seals appears to be the result of factors causing increased mortality of juveniles classes at sea. Entanglement in debris, especially lost fishing nets or fragments, may be a significant cause of mortality, but other factors also may contribute. Organic pollutants, accumulated on the winter range, which adversely affect reproduction in other pinnipeds (Delong et al., 1973; Reijnders, 1986) do not appear to be have a significant impact on fur seal reproduction. Neither did the 1983 El Nino episode appear to alter fur seal food availability in Pribilof foraging areas as may have been the case on San Miguel Island where female foraging trips increased in length during this period.

Since much of the fur seal's insulation derives from the pelage rather than a thick fat layer, they rapidly incur fatal hypothermia if the fur layer is fouled by oil. Oil also may be transferred to pups by females

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returning from feeding trips. Impacts of oiling, including surface contact; inhalation and ingestion; as well as noise associated with development, are discussed in DOI, MMS (1985) and by Geraci and St. Aubin (1988).

Significant impacts of oil and gas development on the fur seal population are most likely to occur when seals are concentrated in the eastern Aleutian-Pribilof Island axis in late spring, summer, and fall. Near several rookeries where summer densities are 250+ seals per square kilometer, up to 77,000 seals could be contacted by a 10,000-barrel oil spill, estimated to form a discontinuous slick covering 310 square kilometers (Ford, 1985). Mortality of this magnitude could result in a high level of impact. In pelagic areas further offshore, along the shelfbreak and nearer to the Aleutian Islands, where densities are lower, impacts are more likely to be moderate. Likewise, where densities are relatively low, along most of the migration route, in wintering areas, and in the vicinity of the Pribilof-Unimak Pass corridor early in the breeding season, impacts of an oil spill are likely to be low. A large volume oil spill, essentially surrounding the Pribilof Islands, thereby forcing a large proportion of the population into contact, could result in very high impacts.

An oil spill contacting the Pribilof Islands-Unimak Pass intensive use area is most likely to originate from existing leases in the St. George Basin or North Aleutian Basin, or from tankers serving Navarin or Norton Basins as a result of previous lease sales. The probability that oil spilled in the St. George Basin (DOI, MMS, 1985) would contact the islands within 30 days in summer can be as high as 71 percent, and greater than 99 percent for entering the area within ar0-mile radius surrounding them. Fur seals foraging to the north of the islands could be contacted by an oil spill in the Navarin Basin. Those migrating in the Gulf of Alaska and futher south could be contacted by oil spills from tankers transiting the west coast from the TAPS terminal in Valdez. Fur seals wintering off California or breeding on San Miguel Island could be exposed to oil spills originating from existing production in the Southern California Planning Area. For this analysis, it is assumed that an oil spill would contact the Pribilof Islands as a result of development on existing leases in the St. George Basin. This could result in a moderate impact to the species.

Helicopter traffic between St. Paul and the St. George Basin is likely to result in very low impacts among males establishing territories in spring. Disturbance of rookeries when pups are present could have more serious impacts, but still are likely to be low. Designation of alternate air traffic corridors could mitigate potential impacts of this activity. Vessel traffic is not likely to have significant impacts. Impacts from air and vessel traffic are not expected to be sufficiently adverse to increase the aggregate impact to a level greater than that for oil spills, but their occurrence could cause the cumulative impact to occur with greater certainty.

The fur seal's migratory habits could expose the population to impact producing agents associated with oil and gas development in several planning areas included in the current and future 5-year programs (Navarin, Norton, St. George and North Aleutian Basins; Shumagin, Kodiak, Cook Inlet; Gulf of Alaska, Washington/Oregon; and all of California). The cumulative number of oil spills estimated for this substantial area from all sources is 52 (see Table IV.B.4-2), including tankers carrying Beaufort and possibly Chukchi Sea oil via the TAPS, to which fur seals could be exposed along much of their migration route. This suggests that multiple oil spills could contact various segments of the population, in the same year or sequentially, over the life of the current or future 5-year programs. Multiple large oil spills contacting rookery areas during the pupping season, or vicinity of Unimak Pass at peak migration, within the equivalent of a generation (i.e., 4-6 years) could elevate the potential impact to high or very high levels. Where fur seal densities are much lower than in the vicinity of the Pribilof Islands in summer and fall, development of leased areas as a result of the current and future 5-year programs may not elevate overall impacts significantly above the levels projected for existing lease areas. Disturbance of seal rookeries is not likely to increase significantly as a result of additional activities associated with the 5-year programs.

Where fur seals are relatively concentrated, in the vicinity of the Pribilof Islands in summer and fall and during peak passage through Unimak Pass, a high level of impact could result from an oil spill. Moderate impacts are more likely where densities are substantially lower, farther from the islands, along the migration route south of Unimak Pass, and in wintering areas off California. Since multiple oil spills are more probable with the addition of the current or future 5-year programs, it was assumed that two oil spills contacted the fur seals in the vicinity of the Pribilof Islands during the summer and fall period of peak concentration and during peak passage through Unimak Pass. Therefore, the impacts to the fur seal could be elevated to high or very high levels. Although disturbance impacts are not expected to increase the aggregate impact above that for oil spills alone, they could cause the cumulative impact to occur with greater certainty.

CONCLUSION: The cumulative impact on the northern fur seal is expected to be high.

(2) Steller Sea Lion

The world's Steller sea lion population is estimated at 231,000, including about 89,000 in the Aleutian Islands, 91,000 in the Gulf of Alaska, and 12,000 in southeast Alaska. Their range extends south to southern California. Between the 1950's and 1970's, the eastern Aleutian population declined about 50 percent, and since then has continued to decline at about 7 percent per year. The causes of the decline are unknown but may involve reduced fecundity or increased mortality. Numbers in the central Aleutians are stable, and those in the central and western Gulf of Alaska are declining, but at a lower rate than in the eastern Aleutians. No commercial harvest has occurred since 1972.

Activities that could produce important adverse impacts on sea lions include oil and gas development on current leases in the Bering Sea and Gulf of Alaska, and commercial fishing operations. Altered prey distribution/abundance, and diseases, particularly those resulting in reproductive failure or juvenile/adult mortality, may be important factors in declining sea lion populations. Evidence of two disease organisms that could be responsible for reproductive failure and mortality has been found in Alaskan sea lions (Merrick et al., 1987). Changes in the abundance of the size prey (pollock) thought to be preferred by sea lions have occurred (the large fish targeted in the pollock fishery), but too little information on sea lion foraging patterns is available to confirm or reject a relationship between the changes and sea lion declines.

Factors, which by themselves are unlikely to explain the declines in some areas but which may contribute to them, include changes in oceanographic conditions, subsistence harvest, predation, killing of individuals for bait and predator control, entanglement in net fragments and other debris, incidental taking in fisheries (which may be substantial), harassment, chemical pollutants, and residual impact of commercial harvest. How important most potential factors currently are is speculative. It is evident that in the eastern Aleutians and perhaps in the western Gulf of Alaska some factor or factors are causing a high impact.

Since the insulation among older sea lions derives from a thick fat layer, they are relatively insensitive to oil contact; however, oil may be transferred to the more sensitive pups by females returning from feeding trips. Impacts as a result of contacting, inhaling and ingesting oil, as well as noise associated with development, are discussed in DOI, MMS (1985) and by Geraci and St. Aubin (1988).

Significant impacts of oil and gas development on the sea lion population are most likely to occur when sea lions are concentrated at rookeries in late spring, summer, and early fall. Major rookeries are located in southeast Alaska, northeastern Gulf of Alaska, south of Kodiak Island and the Alaska Peninsula, throughout the Aleutians, on Walrus Island in the Pribilof Islands, and on Amak Island north of the Alaska Peninsula. Currently, oil-spill impacts probably would be most severe in the eastern Aleutians where the sea lion population is declining sharply. An oil spill contacting this area is likely to originate from existing leases in the St. George Basin, or potential transportation by tanker from existing leases in Navarin or Norton Basin if oil is discovered. Except in the event of a tanker grounding in the Unimak Pass area, the probability of an oil spill contacting this area within 30 days in summer ranges up to 78 percent (DOI, MMS, 1983).

Following the breeding season, movements between rookeries and haulouts occur, as well as a substantial movement of males north to St. Lawrence Island, and a movement of individuals from the Aleutians to the ice front of the central Bering Sea in winter. Sea lions involved in these movements could be at risk from oil spills originating in the North Aleutian, St. George, Navarin, and Norton Basins; and thereby, would be subject to low impacts.

Post-breeding season dispersals by sea lions could result in their exposure to oil spills in several areas proposed for leasing as a result of the current and future 5-year programs. Documented dispersals include: movements throughout the Gulf of Alaska and south to British Columbia; northward movements from California to the Pacific Northwest, Canada, and southeast Alaska; movements north to St. Lawrence Island and the ice front. Movements between the three North Pacific areas where segments of the sea lion population are concentrated (Aleutian - Bering Sea, Gulf of Alaska, southeast Alaska - California) potentially could expose some portion of the population to oil spills estimated to occur over

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the next 35-to 40-year period. Exposure is more likely to be restricted to these subregions where 19, 13, and 20 oil spills are estimated, respectively (see Table IV.B.4-2).

The population is most vulnerable where substantial rookeries are located (a large proportion of overall pup production occurs at a relatively few rookeries) and declines are being experienced, mainly the eastern Aleutian and western Gulf of Alaska areas. In such areas, moderate to high oil spill impacts could occur. Likewise, oil spills in the vicinity of the larger rookeries in California, Ano Nuevo Island and Cape Mendocino, could result in moderate to high impacts for this region. As a result of substantial movement within, and to some extent between, these areas, multiple oil spills could contact various segments of the population, in the same year or sequentially over the next 35- to 40-year period. Therefore, two oil spills were assumed to contact the species during the steller sea lion's migratory route.

Multiple large oil spills contacting rookery areas during the pupping season within the equivalent of a generation (i.e., 3-5 years) could elevate the potential impact, particularly in areas where the population is declining. Where densities are substantially lower, such as in Alaskan areas with relatively minor rookeries and haulouts (e.g., northwestern Gulf of Alaska, northern Bristol Bay, central Bering Sea) and from southeast Alaska southward, development of leased areas as a result of the current and future 5-year programs may not elevate overall population-level impacts significantly higher than levels noted above. Although locally the impacts may be quite significant, occurrence may become more certain. Disturbance of sea lion rookeries is not likely to increase as a result of the current and future 5-year programs.

In the eastern Aleutians, where sea lions apparently are experiencing high to very high impacts from non-OCS factors, the additional impacts of oil spills could highly influence their survival. In other portions of their range where they are concentrated, primarily in the vicinity of major rookeries in summer, a high level of impact could result from an oil spill, especially in areas of declining population. Low to moderate impacts are more likely where densities are substantially lower, such as in the vicinity of minor rookeries, haulouts, and wintering concentrations throughout their range from Alaska to California. Multiple oil spills, more probable as a result of the addition of the current and future 5-year programs, could increase impacts particularly in areas where the population is declining. Disturbances are not expected to increase the aggregate impact above that for oil spills alone.

CONCLUSION: The cumulative impact on the Steller sea lion is expected to be moderate.

(3) Guadalupe Fur Seal

These animals are known to breed only on Guadalupe Island, Mexico. In the Pacific Region, a few nonbreeding individuals have been seen on San Miguel Island each year since 1969 during the breeding season (Seagars, 1984). The number of seals seen on the island has ranged from one to a maximum of five animals in 1978. The species has also been seen at San Nicolas, San Clemente, and Santa Barbara Islands (Stewart et al., 1985).

Pre-exploitation population levels have been estimated at 30,000 animals. The latest count (Seagars, 1984) is of some 1,600 animals. However, Seagars (1984) indicates that the population is probably increasing at a rate of 5 percent based on censuses done in 1977 and 1984.

The major reason for the decline of this species was over-hunting in the late 1800's to early 1900's (until it was thought to be extinct). Other man-caused disturbances (noise and vessel traffic) probably impacts this species as they impact other pinnipeds; however, the Guadalupe fur seals their numbers are so low they rarely come in contact with these impacting agents. Impacts of commercial fishing in waters adjacent to breeding areas on Guadalupe Island, Mexico, or the (as yet unknown) feeding grounds are not known.

Unlike other pinnipeds, fur seals rely on their fur for insulation from the cold marine environment. Oil reduces its insulation value by removing natural oils which waterproof the pelage. Kooyman et al. (1976) reported that fouling only one-third of the body of a fur seal results in a 50 percent greater heat loss that eventually leads to hypothermia and death. Therefore, fur seals, unlike other pinnipeds, are extremely vulnerable to contact with spilled oil.

The estimated mean number of oil spills in the Southern California Planning Area from existing activities is 7 (see Table IV.B.4-2). In this analysis, a large oil spill is assumed to occur and contact the northern Channel Islands (especially San Miguel Island) during the next 35 years. Since fur seals are only seasonally present on the islands, an oil spill would have to occur in May-July to impact these animals. If such an oil spill were to occur and contact San Miguel (or San Nicolas) Island when fur seals are present,

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impacts could be moderate if the few seals present are assumed to be killed. It would take several years (at least more than one generation) for the population to reappear at these sites. However, assuming that spills are likely to occur in any season, the probability of an oil spill contacting San Miguel when seals are present is 25 percent. It is, therefore, unlikely that an oil spill would occur and contact San Miguel or San Nicolas Islands while the fur seals are present.

Since seals are pelagic in the nonbreeding season and could be found anywhere in the Southern California Bight, the only activity of the current or future 5-year programs that may impact them is vessel traffic from supply and crew boat bases to and from drilling rigs or platforms. The additive impact of this activity combined with other proposed and existing projects and activities in the area is expected to increase the amount of noise and disturbance on fur seals. However, the incremental addition of those activities is not expected to increase the level of impact to this species above the current levels as a result of existing projects or proposals.

The additional risk of an oil spill as a result of the addition of the current and future 5-year programs is significant for the Southern California Planning Area (See Table IV.B.4-2). It is difficult to estimate what this increased risk translates into in terms of actual oil spills. For the purpose of this analysis, it is assumed that the additional oil spills will contact other areas. (Therefore, no island is contacted more than once by an oil spill as opposed to a single island being contacted several times.) Using this assumption, the increased risk does not result in an increased risk for this species since as San Miguel Island and, to a lesser extent, the southern Channel Islands, which are the more important haul-outs areas, are not expected to be contacted more than once during the life of the project.

CONCLUSION: The cumulative impacts from OCS and non-OCS activities within the range of California Guadalupe fur seals are expected to be very low.

(4) California Sea Lion

The world population of the California sea lion (not including the population in the Galapagos) is estimated to be over 157,000 animals (DOC, 1987).

In the Pacific Region, the California sea lion is the most abundant pinniped on land and in waters over the continental shelf (200 m in depth). Total population growth estimates, based on pup production records, are about 7 percent, representing a potential doubling of the population every 10 years (Bonnell et al. 1983). As a result of increased numbers, animals are also expanding their range. Sea lions are becoming common offshore the Pacific Northwest where they were almost unheard of before the 1970's.

As evidenced by their exponential growth rate (Bonnel et al., 1983:80), the California sea lion population appears to be little affected by anything currently taking place in their environment. The California sea lion is a highly adaptable species and is known to tolerate a multitude of incidental disturbances. When disturbed from rookeries by man or storms, they are known to move to nearby areas and reconstitute social structures (Peterson and Bartholomew, 1967). (Unlike most other pinnipeds, sea lions are known to have coexisted with Native Americans on offshore islands for thousands of years.) As such, it is obvious that man-caused noises in the marine environment (e.g., vessel traffic, helicopter traffic, exploratory and development rigs) have little impact on the California sea lion population. (However, this is not to say that excessive, widespread harassment (especially on rookeries) has no impact on this species.)

The NMFS authorizes an incidental take of almost 2,000 sea lions a year by commercial fisherman (DOC, 1987). Based on current population levels, the sea lion population, as a whole, appears to be little impacted by gill net mortality.

Organic pollutants are known to cause reproductive failure in harbor seals (Reijnders, 1986), and DeLong et al. (1973) suggest a possible cause-impact relationship between high levels of organic pollutants and premature birth in California sea lions. However, this type of mortality probably claims only a small portion of the year's pup population. (DeLong et al. (1973) counted 290 premature pups for some 10,000 females on San Miguel Island and 442 dead pups for 5,500 females on San Nicolas Island.) Therefore, over the next 35-year period, organochloride pollutants are expected to have a negligible impact on the California sea lion population as a whole.

Impacts of an oil spill on pinnipeds are discussed in the FEIS (Section IV.A.4.c.5). Pinnipeds other than fur seals appear not to affected greatly by spilled oil (St. Aubin, 1987). Only in cases of very large oil spills has any outright mortality been noted in these pinnipeds. Further, sea lions appeared not to have

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been greatly affected by the Santa Barbara oil spill (Bonnell and LeBoeuf, 1971) or by natural oil seeps in the Santa Barbara Channel.

Oil spill impacts are largely sublethal. It is estimated that an oil spill would have to contact two rookeries in the Pacific Region within 4-6 years (1 generation) during the breeding season to have an impact greater than very low on this species.

The only impacting agent associated with the addition of the current and future 5-year programs that may affect sea lions is vessel traffic from supply and crew boat bases to drilling rigs or platforms. However, the additive impact of this activity combined with other proposed and existing projects and activities is expected to increase the amount of noise and disturbance on sea lions in the Pacific Region. However, the incremental addition is not expected to increase the level of impact to this species above the current existing levels.

The additional risk of an oil spill is significant for the Southern California Planning Area. The estimated mean number of oil spills is 7 from existing oil and gas activities; with the addition of the current and future 5-year programs the estimated number is 12 (See Table IV.B.4-2). Although these oil spills could occur anywhere in the planning area, oil spills near the Channel Islands (i.e., major rookeries) could cause pup mortalities. Combined with the other types of man-caused mortalities (from gill netting and ocean pollution), multiple oil spills near major rookeries during the breeding season within 4-6 years could cause impacts that would be evident for several generations. However, it is unlikely that all these conditions (multiple oil spills near the major rookeries during the breeding season within 4-6 years) would occur.

CONCLUSION: The cumulative impacts from OCS and non-OCS activities within the range of California sea lions are expected to be very low.

(5)Other Pinnipeds

(a) Northern Elephant Seal

Prior to the commercial harvesting of the 1800's, the range of the northern elephant seal, extended from Point Reyes, California, to Cabo San Lazaro, Mexico. The species was thought to be extinct until 1892, when a small population of no more than 100 animals was discovered on Isla de Guadalupe, off Baja California. The present breeding range of the northern elephant seal extends from Isla Natividad in Baja California to Point Reyes in northern California (Bonnell et al., 1983; Allen et al., in press). The population size is estimated at 100,000 (DOC, 1987). Cooper and Stewart (1983) estimate that the population has been doubling every year since the early 1960's.

Like the California sea lion, elephant seals appear to be little affected by anything taking place in their environment. As with sea lions, elephant seals are most vulnerable to disturbances at the island rookeries. And since most of the islands are protected (especially in the United States), these animals experience few disturbances on rookeries. When not on the rookery, these animals are totally pelagic and feed at depths of 350 to 650 meters (.2 to .4 miles) with only 14 percent of their time spent on the surface (Le Boeuf et al., 1987). This makes them less vulnerable to most potentially impacting agents (i.e., vessel traffic, gill netting).

The impact of an oil spill on these animals would come primarily from the cleanup attempt. In the Pacific Region, the most densely populated rookeries occur on San Miguel, Ano Nuevo, and San Nicolas Islands. (Outside of the Region, the most densely populated are Isla de Guadalupe and Isla San Benito off Baja California.) Once on the rookery, these animals fast for the entire period (unlike female sea lions) and, therefore, generally do not leave the island. However, any cleanup effort near, but especially on, the island may cause animals to stampede to the ocean. These animals have evolved physiological and behavioral mechanisms that allow them to remain on the island which facilitates caring for young and maintaining a social hierarchy.

Repeated disturbance of the rookery could lead to: (1) a total breakdown of the social structure (which would lead to reduced pupping) which could cause excessive expenditure of energy of a fasting animal (which could cause them to be susceptible to other decimating factors), (2) the separation of pup from cows (which generally leads to death), and/or (3) the death of pups by stampeding adults. Depending on the number of disturbances, these factors could all lead to a reduced reproductive effort for the season.

Multiple large oil spills occurring and contacting a major rookery from existing oil and gas activities more frequently than 4-6 years or contacting two major rookeries in the same breeding season could elevate impacts one or more levels. However, based on oil-spill assumptions for this analysis, it is estimated that

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oil spills will take place more than 4 years apart and not contact rookeries during the breeding season in the same year. Therefore, impacts from oil spills are expected to very low.

For reasons discussed above, the only potentially impacting agent that could affect elephant seals would be a major oil spill contacting one of the important rookeries during the pupping season. Assuming that the increased number of oil spills from the addition of the current and future 5-year programs (especially in the northern Channel Islands of the Southern California Planning Area) means additional oil spills impacting different islands (as opposed to impacting the same island), the level of impact is not expected to exceed current levels from existing activities.

CONCLUSION: The cumulative impact from OCS and non-OCS activities in the range of northern elephant seal is expected to be very low.

(b) Harbor Seal

Along the west coast of North America, the range of the harbor seal extends from Alaska south to Baja California. The harbor seal is a year-round resident along the coast of the Alaska/Pacific Regions, hauling out on islands, estuaries, secluded beaches, and offshore rocks along the length of the coastline (Bonnell et al., 1983; Hanan et al., 1988). The most recent estimate of the population size is 320,000 animals, of which 42,000 (13 percent) are found south of Alaska (DOC, 1987).

Based on censuses performed from 1982-1986, the harbor seal population in California appears to be stable. The NMFS estimates that the population in Oregon has increased by 7 percent annually since 1977 and about 10 percent annually in Washington since 1976 (DOC, 1986).

The status of the species in Alaska is less clear, however. Hoover (1988) presents a discussion on the problems of obtaining quantitative data on seals in Alaska and summarizes information on the population trends. In summary, it appears that the populations along the northern Alaskan Peninsula (Hope Basin Planning Area) and on Tugidak Island (in Kodiak Planning Area) are declining. The population in the Gulf of Alaska is believed to be increasing. Populations elsewhere are presumed to be stable.

Impacts to harbor seals are essentially the same as those already discussed for the harbor porpoise and the California sea lion. These include gill netting, nearshore pollution, and noise from vessel traffic. (Additionally, a detailed discussion of impacting agents and their possible impacts on harbor seals, especially in Alaska, is presented in Hoover (1988).)

The factor having the most severe impact has been overharvesting in the recent past (just prior to passage of the Marine Mammal Protection Act in 1972), especially in Alaska. In fact from 1920 to 1967, the State of Alaska paid bounties to encourage seal harvest to reduce conflicts with commercial fisheries. In the Alaska Region, the areas where the population appears to be declining invariably received intensive harvesting pressure in the past.

As the populations of harbor seals in most of the Pacific/Alaska Regions (note exceptions in Alaska above) are either stable or increasing, it is estimated that impacts from existing activities are negligible to very low.

The impacts of oil spills on harbor seals are similar to those already discussed for other non-furbearing pinnipeds (elephant seals and sea lions; also see St. Aubin, 1988). Newborn harbor seal pups (less than 10 days), however, may be more susceptible to oiling since they rely on their lanago, birth coat, for insulation until they have developed a thick subcutaneous blubber layer. Although oiling may not cause outright death through hypothermia, it may lead to death from increased thermal stress in these young animals.

As with the other pinnipeds previously discussed, it is estimated that due to their less vulnerability to spilled oil (except in cases where an oil spill contacts a rookery in the breeding season) harbor seals would experience very low impacts from oil spills during the next 35 to 40 years.

The normal activities associated with the current and future 5-year programs that may impact harbor seals include the drilling of exploratory and development/production wells, vessel traffic from supply and crew boat bases to drilling rigs or platforms, and helicopter traffic. The additive impact of these activities, combined with other proposed and existing projects and activities, is expected to increase the amount of noise and disturbance on harbor seals in the Alaska/Pacific Region. This incremental addition is not expected to increase the very low impact that may result from existing activities.

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The only potential impacting agent that could affect harbor seals would be a major oil spill contacting one of the important rookeries during the pupping season. Assuming that the increased number of oil spills (especially in the northern Channel Islands of the Southern California Planning Area) means additional oil spills impacting different Islands (as opposed to impacting the same Island), the increased risk is not expected to increase the level of impact above what is expected from existing activities. Multiple large oil spills occurring and contacting a major rookery more frequently than 4-6 years or contacting two major rookeries in the same breeding season could elevate impacts one or more levels.

CONCLUSION: The cumulative impact from OCS and non-OCS activities on harbor seals is expected to be low.

d. Polar Bear

Polar bears in Alaska belong to two populations, Beaufort Sea and Chukchi Sea. Little interchange occurs across a boundary between Pt. Lay and Pt. Barrow. The current estimate for the total Alaskan population is 3,000 to 5,000. They are most abundant in drifting pack ice in winter and near the pack ice edge in summer.

Activities that could produce adverse impacts on polar bears include oil and gas development on current Federal leases in the northern Bering, Chukchi and Beaufort Seas; current and future State oil and gas production; oil and gas development on the Arctic National Wildlife Refuge; Canadian Beaufort development and production; Red Dog Mine; and subsistence harvest. Altered prey availability also could affect polar bear distribution and abundance.

Although polar bears are very sensitive to oil contact, their low population density, solitary habits, and ability to forage out of water suggest that few would be contacted by an oil spill; thus, potential oil-spill impacts on their regional population are likely to be low. Likewise, the number of bears affected indirectly through local reduction of seals or ingestion of oil by eating contaminated seals is likely to be small, and population impacts to be low or very low.

Disturbance from noise and human activities, (including aircraft, vehicles, and other activities associated with seismic surveys; vessel operation; construction of offshore causeways and gravel islands; construction and operation of offshore platforms and onshore facilities; and subsistence hunting), could displace polar bears from within several kilometers of where these activities are localized. Such changes are likely to last for the duration of the activity. Likewise, displacement of ringed and bearded seals from these areas could result in corresponding changes in polar bear distribution. However, since the density of polar bears throughout most of their range is extremely low, and the amount of displacement and change in habitat use is likely to be relatively small in comparison to the natural variability in seasonal habitat use, overall disturbance impacts are expected to be low.

The most serious consequence of disturbance may be the displacement of pregnant females from preferred denning areas. Although the impacts of current development on polar bear denning are not known, dens typically are more sparsely distributed along the Alaskan coast than in other parts of the range so impacts probably would not exceed a low level. Nor is the coastal facility associated with Red Dog Mine likely to have a significant impact. Polar bears also may be attracted to sites of human activity in their search for food, potentially resulting in removal of individual bears from the population. Currently, only Natives are allowed to take polar bears in Alaska; this take is essentially without restriction. Reported take from 1980-1985 averaged 135 bears per year; this may represent approximately 21 percent of total mortality (Amstrup and DeMaster, 1988), and is many times the number of bears likely to be affected by oil spills or disturbance factors.

Although extensive annual movements of polar bears have been documented within the two regional population ranges, they do not appear likely to travel through, and thus be exposed to, oil spills in more than two or three planning areas in this timeframe. The with the addition of the current and future 5-year programs 25 oil spills are assumed to occur in the areas where polar bears range (eg. Beaufort and Chukchi Seas, and Hope, Norton and Navarin Basins). However, only 10 of these are estimated for the primary range north of the Bering Strait, the remainder occurring further south where polar bear numbers are extremely low. As a result of low density throughout their range, it appears likely that polar bears would experience only low impacts from oil spills. Also, it does not appear likely that disturbance from noise and human activity associated with oil and gas development in these planning areas would displace significantly more bears than do current leases and other activity.

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CONCLUSION: The cumulative impact from OCS and non-OCS activities on polar bears is expected to be low.

2. Marine and Coastal Birds

a. Threatened or Endangered Birds

(1) Arctic and American Peregrine Falcon

The U.S. Fish and Wildlife Service estimates that 200 pairs of arctic and 400 pairs of American peregrine falcons historically nested in Alaska. Beginning in the late 1940's, the use of the organochlorine pesticides greatly affected peregrine falcons, causing birds to lay thin-shelled eggs which often failed to hatch and consequently lowered reproduction. In Alaska, the population of arctic peregrine falcons declined to approximately 30 percent of historical levels. In 1978, a number of years after the U.S. had restricted the use of organochlorine pesticides, the peregrine falcon population began to increase. Based on 1988 surveys, the population of arctic peregrine falcons now stands at about 80 pairs and 120 young. The population of American peregrine falcons is estimated at about 225 pairs in Alaska and about 64 pairs in California. The current trend for both subspecies is for gradually increasing numbers (DOI, FWS, 1989; Ambrose, pers. commun., 1989).

There are a limited number of the OCS and non-OCS projects or proposals that could affect peregrine falcons. However, any noisy activity or large-scale habitat alteration near nesting sites and locations are the types of actions that would adversely affect peregrine falcons.

Two existing projects or proposals that may affect arctic peregrine falcons would be offshore mining in Alaskan waters near Nome, and the OCS Mining Program Norton Sound Lease Sale. Potential impacts as a result of these two projects would be related to the mining and processing of the ore. As a result of these activities, mercury concentrations in the water column may be increased. Mercury can readily bioaccumulate and biomagnify within the marine food chain and eventually result in reduced reproductive success in birds.

Several pairs of arctic peregrine falcons nest on coastline cliffs in the area and feed on resident seabirds. Consequently, mercury may impact seabird reproduction and eventually result in the reduction of prey availability for the falcons. It may also accumulate at high levels in the peregrine falcons and cause direct mortality or accompanying reduced reproductive success. The effect of mercury on peregrine falcons may result in the loss of some or all of the six nesting pairs near the Proposed Norton Sound Lease Sale Area, and is expected to result in a moderate level impact on the northwest Alaska coastal arctic peregrine falcon population (approximately 20 to 30 pairs) (DOI, MMS, 1988).

Oil spills and noise as a result of previous Federal and State oil and gas lease sales have the potential to affect peregrine falcons. Peregrine falcons feed principally on birds, preferring to take their prey in flight. Consequently, it is unlikely that spilled oil would contact the falcons directly. However, it is possible that peregrines could be oiled while feeding on partially oiled seabirds, waterfowl, or shorebirds. Also, peregrines could be affected by a reduction in prey availability, if a large number of birds in the area are contacted by spilled oil and die.

Nesting peregrine falcons could be disturbed by the noise of helicopters passing low overhead between support bases and exploration units or production platforms. This disturbance could possibly result in abandonment of nest sites, nestling mortality, and reduced reproductive rates.

The use of persistent pesticides even in reduced quantities has resulted in continued contamination in the peregrine falcon. The ban of DDT and related pesticides in the United States has greatly reduced the bioaccumulation of these chemicals in peregrine falcons, thereby it has reduced reproductive failures. However, the continued use of persistent pesticides (including DDT) in the Third World Countries of Central and South America where peregrines winter and migrate, has resulted in a persistence of contamination in peregrine falcons.

Habitat destruction can also adversely affect peregrine falcons. Large-scale habitat destruction in Central and South America (clearing of forests for agriculture). Commercial and residential construction in coastal areas could result in less suitable habitat and prey for peregrine falcons which could result in a lower reproductive rate. Destruction of wetlands along migration routes and within feeding territories also could reduce the prey base and slow the recovery of the falcon species.

The impacts to the peregrine falcons as a result of the activities associated with the current and future 5-year programs would be similar in nature to those previously described. Slightly higher impact levels may be estimated from increased levels of noise and disturbance from helicopter operations associated with the increased levels of exploration and production anticipated.

The development and production scenario for the Chukchi Sea Planning Area (DOI, MMS, 1985) anticipates construction of an onshore pipeline from Point Belcher to the Trans-Alaska Pipeline (see Section IV.C.). At this time only a hypothetical corridor has been identified; however, it appears that the pipeline has the potential to pass in close proximity to a number of peregrine falcon nesting sites. Should this activity occur, it has the potential to disturb a number of nesting pairs and may lead to abandonment of nest sites, nestling mortality, and a reduced rate of reproduction.

The combined impacts from a variety of impacting agents may result in the death of a low number of peregrine falcons, the short- or long-term abandonment of some nest sites, and the likelihood of a reduced reproductive rate. Bioaccumulation of trace metals such as mercury resuspended by offshore mining programs may result in the direct mortality of a few peregrine falcons or in reduced reproduction in those coastal-nesting pairs near the mining area. Noise and disturbance from helicopter operations associated with OCS and non-OCS activities may result in the abandonment of nest sites, which could possibly cause nestling mortality and thereby, a reduced reproductive rate. Continued use of persistent pesticides and habitat disturbance or destruction along migration routes and in wintering areas would likely have sublethal impacts that may result in reducing reproductive rates and slowing the recovery of the species. The most obvious effects (potential mortality and noise disturbance of nesting birds) would be generally limited to coastal-nesting pairs which comprise a small portion of the peregrine falcon population. It is expected that overall cumulative impacts from non-OCS and OCS activities on peregrine falcons would be low.

CONCLUSION: Since only a small portion of the peregrine falcon population, in Alaska and California, is likely to be affected by the activities of the current and future 5-year programs, the overall cumulative impacts are expected to be low.

(2) Short-tailed Albatross

The short-tailed albatross was once abundant and widespread in the North Pacific, including coastal areas from Alaska to Baja California where upwellings brought nutrient-rich waters to the surface. Historically, it was probably the most abundant albatross in Alaska waters and is reported to have numbered in the low millions (Hasegawa and DeGange, 1982). By the 1930's, following 50 years of exploitation for their feathers and oil, the species was reduced to fewer than 100 birds. The species has been protected by the Japanese government since 1933, and numbers have slowly increased to a current population of about 400 birds. Through continued protection and habitat improvement efforts on the breeding grounds, the population is continuing to increase.

Existing projects or proposals that could affect the short-tailed albatross would include commercial and subsistence fishing, ingestion of waste material, and previous State and Federal oil and gas lease sales.

The short-tailed albatross is a surface-feeder, and is believed to feed nocturnally on squid, (Hasegawa and DeGange, 1982). Short-tailed albatrosses are also known to follow marine vessels and will sometimes consume discarded offal. This behavior indicates that individuals could become entangled in fish nets (including active, discarded, or lost gear) or caught on hooks in trolled or long-line gear. Two dead short-tailed albatrosses have been recovered by commercial fishermen in the last six years, one from a net and one from a long line (Amaral, pers. commun., 1989). The fishing industry may also compete with albatrosses for prey species such as walleye pollock and sablefish, which have larval or juvenile stages that occur at or near the surface. Lastly, albatrosses could be harmed or die by contacting petroleum products leaked or spilled by vessels in the commercial fishing fleet.

Albatrosses could suffer injury or mortality from the ingestion or entanglement with plastics or other debris disposed of overboard. Section IV.C. contains a brief description of the magnitude of waste materials lost or disposed of at sea. Albatrosses were among those seabirds observed to ingest plastics most frequently (Day et al., 1985). Ingestion of plastics can result in intestinal blockage and lesions. Plastic particles have been found among food items brought by adult short-tailed albatrosses to feed developing chicks. It appears that plastic pollution is a growing threat to the species (Hasegawa, pers. commun., 1988).

The impacts from, existing oil and gas exploration, development and production from previous State or Federal lease sales on short-tailed albatrosses would be similar to those previously mentioned (impacts of spilled oil and the disposal of waste materials). The Consolidated Offshore Operating Regulations (30 CFR 250) which govern oil and gas activities on the Federal OCS prohibit the disposal of solid wastes and other materials at sea, and should help to mitigate the problem of discarded plastic wastes.

Even with the activities associated with the current and future 5-year programs, the impacts are estimated to be similar in nature to those previously discussed. However, a greater number of oil spills would be estimated to occur. The mean estimated number of oil spills within the broad oceanic range of the short-tailed albatross from all sources over the next 35- to 40-year period would be about 62 oil spills (see Table IV.B.4-2). If individual albatrosses contacted spilled oil they would probably die. But, it is unlikely that very many individuals would contact spilled oil since the 400 individuals in the population are presumably well scattered over much of the North Pacific and Bering Sea during the non-breeding season from May to November. As the population continues to grow, of course, the probability of one or more birds contacting an oil spill will gradually increase. Therefore, the cumulative impacts on the short-tailed albatross are estimated to be low.

CONCLUSION: The cumulative impacts on the short-tailed albatross are expected to be low.

(3) California Least Tern

Once California least tern's nesting habitat sandy ocean beaches was fairly common. However, increased human activity has made these areas largely uninhabitable, breeding, therefore, occurs on some 20 isolated coastal areas. The majority of the breeding sites are located in southern California on military bases (Seal Beach Weapons Station and Camp Pendelton). The FWS estimated that from 1974 to 1977 the least tern's population ranged from about 580 to 770 breeding pairs and from 1984 to 1987 from 940 to 1,020 breeding pairs. However, since these birds once numbered in the tens of thousands along the central California coast to northern Baja, these figures still represent a depressed population.

The most significant impacting agent affecting least terns is the destruction of nesting and feeding habitat due to the development of the southern and central California coastline. (See Section IV.C for discussion of loss of coastal habitat in California.) Coastal highway construction, recreational development, and construction of beach cottages have reduced habitat and permitted increased human access to least tern nesting beaches. Feeding areas have been filled in, developed, and polluted. The continued loss of shoreside nesting and feeding habitat, along with high levels of human disturbance and predation by coyotes, foxes, and domestic animals at the remaining colonies, have been responsible for the dramatic decline in numbers. It is unknown what impacts the least terns are experiencing in Mexican waters during the nonbreeding season. Assuming no more habitat is destroyed as project in the FWS recovery plan, and human disturbance and predation remain at the current level, it is estimated that these impact factors would have a moderate level of impact on this species.

Like most avian species, least terns are vulnerable to oil spills (see discussion in Section IV.A.4.c.6 in the FEIS). Since least terns seasonally breed in about 10 widely-spaced locations (in some 20 colonies) from Morro Bay to the Mexican border (DOI, FWS, 1980), an oil spill would have to occur and contact the birds while they are present at this sites (from May-September) to cause impacts to the species. If an oil spill should occur and contact a breeding colony, it is assumed that adult and/or chick mortality could result. Based existing level of oil and gas activities in southern California and the estimated mean number of oil spills (7) (see Table IV.B.4-2), it is assumed that an oil spill could contact the breeding locations or colonies during the breeding season. Therefore, impacts levels could be elevated to high.

The primary consequence as a result of the activities associated with the current and future 5-year programs is the increased risk of an oil spill occurring and contacting habitat in the Southern California Planning Area. The estimated mean number of oil spills from all oil and gas activities increased to 12 (Table IV.B.4-2) in the Southern California Planning Area. With an estimated mean number of 12 oil spills over the next 35 years, it is assumed that at least one spill could occur and contact least tern habitat during the breeding season. If an oil spill should occur and contact the breeding habitat when terns are present, impacts are expected to be high, since the expected mortality to this population which is in danger of becoming extinct would take about 2 generations (6-9) years to recover from the impacts. If no oil spills contact this species, impacts are expected to remain at the moderate level expected without the current and future 5-year programs.

Impacts from onshore oil and gas facilities could result in the loss of important habitat, currently this is unlikely as extensive mitigation is required to prevent such losses on all existing projects. Therefore, impacts from this source is expected to be negligible.

CONCLUSION: The cumulative impacts from all OCS and non-OCS activities within the range of the California least tern are expected to be high.

(4) California Brown Pelicans

The history of the California brown pelican's decline due to the bioaccumulation of chlorinated hydrocarbons (DDT, DDE, dieldrin, and endrin) in the food chain and scarcity of food (i.e., anchovies) is well documented in the literature (see Section III.A.3.a). After the dumping of chlorinated hydrocarbons into the Southern California Bight was terminated in the early 1970's, pelican reproduction began to improve (Anderson et al., 1975).

Pelicans are now successfully breeding on both Anacapa and Santa Barbara Islands in the Channel Islands National Park. But, during the past few breeding seasons the Pelicans in the Coronados colonies (in Mexico) have not been breeding successfully.

Briggs et al. (1983) observed approximately 24,000 post-breeding birds ashore and at sea in northern and central California in July of 1980 and 1982 and 33,000 in 1981. In 1983, Briggs et al. estimated the total California populations as high as 80,000 to 110,000.

Post-breeding brown pelicans are very tolerant of moderate human activity, especially on daytime roost (Jacques and Anderson, 1987). Pelicans are a common sight in harbors and wharfs all along the coast following the breeding season. Indications are that these post-breeding birds can habituate to low level, chronic disturbances. Breeding birds and birds on nighttime roost, however, are much more sensitive (Anderson, 1988; Jacques and Anderson, 1987).

Since the breeding colonies are protected in the U.S. (on Anacapa and Santa Barbara Islands), the major impacts from human disturbances occurs to the post-breeding pelicans at nighttime roosting areas. In the Southern California Bight, San Miguel, and Santa Cruz Islands are the most important roosting areas. There is a lack of undisturbed nearshore roosting habitat in the Southern California Bight, since the Long Beach breakwater is the only nearshore roost in the area. However, in northern and central California (and presumably in Oregon and Washington), there are more offshore rocks and, therefore, more undisturbed roosting habitat. As yet, the availability of roosting habitat does not appear to be limiting pelican numbers. Impacts from human disturbances appear to have only sublethal impacts on this species.

A major concern is the potential for an oil spill to impact brown pelicans, however, significant oil spill impacts have not occurred as a result of past oil spills. No pelicans were reported oiled in the 1969 Santa Barbara oil spill. Only twenty-five juvenile pelicans were oiled as a result of the 1973 oil spill from the Navy vessel *Manatee* which contacted the shoreline from San Clemente to the Mexican border (DOI, FWS, 1983). This oil spill occurred during late summer when a large number of birds were dispersed throughout the area. Nero and Associates (1982) reported that juvenile pelicans made contact with oil more than adults, which suggest adults may learn to avoid oil. Nevertheless, it is assumed that a major oil spill located near a large colony, feeding area, or roost would impact large numbers of birds. If a large oil spill occurred and contacted the following areas, impacts to brown pelicans are expected to result in a population decline that would last about 3-5 years 1) Anacapa or Santa Barbara Island during the breeding season (i.e., January to March); 2) San Miguel Island, Santa Cruz Island, the southeast Farallon Islands, or the Long Beach breakwater during the post breeding season (May to November); and 3) the major offshore feeding areas near Point Arguello/Point Conception and Point Arena during the post breeding season.

Based on the estimated mean number of oil spills (7) for the Pacific Region from existing oil and gas activities and for the purpose of this analysis, it was assumed that a large oil spill would contact at least one of these areas during a sensitive season over a 35 year period. Based on that assumption, impacts are estimated to be moderate for brown pelicans. However, if a large oil spill contacted one of these areas twice within 3-5 years (i.e., 1 generation) or more than one of these areas in the same year, impacts would be high.

Since other impacting agents do not appear to have lethal impacts on pelicans, the primary consequence from the addition of the activities associated with the current and future 5-year programs is the increased risk of an oil spill occurring and contacting habitat in the Northern, Central, and/or the Southern

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California Planning Areas (and to a lesser extent the Oregon and Washington Planning Area). The expected mean number of spills increased from 7 (from existing oil and gas activity) to 12 with the inclusion of activities from the current and future 5-year programs in the Southern California Planning Area; in Central California Planning Area it increased from 3 to 4; in Northern California Planning Area it remained the same at 1 (See Table IV.B.4-2).

It was assumed that the additional oil spills translate into different areas being contacted (as opposed to the same area being contacted, again). Therefore, the additional oil spills increases the likelihood that another sensitive pelican area (see above discussion) could be contacted within 3-5 years of the first assumed contact. It was assumed that the estimated oil spills would occur with uniform frequency during a 35-year period. Although it is likely that 2 oil spills could occur within a 3- to 5-year period, it is unlikely that it would contact these widely separated areas within the 3- to 5-year period. Therefore, these additional oil spills are not estimated to raise the level of impacts above moderate. However, in the unlikely chance as discussed above, impacts could be high if multiple oil spills contact more than one sensitive area in the same year or the same area within 3-5 years.

CONCLUSION: The overall cumulative impacts to brown pelicans are expected to be moderate.

b. Nonendangered Birds

(1) Geese

(a) White-fronted Goose

The Yukon-Kuskokwim (Y-K) Delta white-fronted goose population recently has exhibited a modest increase after a decade of depressed numbers following a marked decline (85%) from high population levels in the 1960's. The current California winter population estimate (1988) is 161,500 (DOI, FWS, 1989). Probable factors responsible for these trends include climatic variables, subsistence and sport hunting, egg gathering, winter habitat availability/quality, and regulation of harvest activities.

On the delta breeding grounds, where 95 percent of the white-fronted goose population nests, important adverse factors include subsistence harvest of nesting geese and their eggs, and persistent ice and snowcover and/or flooding on nesting areas. Harvest in 1987, was 2,640 (71% of total harvest) and 221 (6%) in spring and early summer, respectively (Copp, 1987). Total harvest on the delta (3,722) was 2.8 percent of the winter population count. Only 110 white-fronted goose eggs were estimated to have been taken on the delta in 1987; it does represent an increase over the previous year of an activity which is prohibited by the Y-K Delta Goose Management Plan.

Current levels of disturbance resulting from aircraft, boats and human activity on the delta, and its effect on geese, are not quantified, but is likely to increase over the next several decades. These disturbances could potentially become a significant adverse factor, especially during the nesting and molting periods when the additional behavioral and energetic stress could cause increased breeding failure, declines in productivity, reduced survival of both adults and young, and delay of critical life-history phases. Potential human activities that could adversely affect goose habitat on the delta include large-scale reindeer husbandry, oil and gas or mineral development, and expansion of residential and recreational land use (DOI, FWS, 1989).

Potential impacts associated with oil and gas production, primarily contact with oil resulting from the oiling of intertidal mudflats, sloughs and meadows, are most likely to occur during the brood rearing, molting, and migration-staging periods (late June-August) when white-fronted geese occupy these low elevation delta habitats. Impacts of oil on individual birds is discussed in DOI, MMS (1985b).

If an oil spill were to occur during this period, chances range from 10 to 100 percent that a substantial proportion of breeding adults and young could be contacted, thereby experiencing increased mortality and/or decreased recruitment for several years (Truett et al., 1984). Residual oil from an oil spill deposited outside this period also could result in substantial oiling of geese. Subsequent release of hydrocarbons in these relatively low-energy habitats could result in long-term adverse impacts. Most nesting occurs on habitats that are more elevated and further inland, and thus less vulnerable to oiling than those commonly occupied by several other goose species.

The source of an oil spill contacting this area is speculative since production from existing leases in Norton, Navarin, or St. George Basins is not anticipated in the near future, and the probability of oil spills from these areas reaching the delta is very low. Another potential activity representing a source of oil spills in this area is tankers passing through the Bering Strait enroute from Canadian Beaufort offshore oil production to Pacific Rim destinations. However, details on the tanker route remain unknown but would likely be quite far from the delta. A grounded fishing boat, fuel barge, or other vessel also could release hydrocarbons in this area.

Following the nesting period and molt, most white-fronted geese migrate without intermediate stops to the Klamath Basin (Oregon/California), especially that portion in northern California, and then to the Central Valley in California with small numbers continuing into central and coastal Mexico. A small proportion of the population (3,000 to 5,000) follows a coastal route from Cook Inlet around the Gulf of Alaska to the Copper River Delta and south to California. In the former two areas, as well as at any other stops further south, geese could be exposed to oil spills from tankers transiting the west coast from the TAPS terminus in Valdez.

In addition, those stopping in Cook Inlet (location of 5 state game refuges) could be exposed to oil spills originating from platforms or tankers associated with current or future production in State waters, or tanker traffic between TAPS and refineries located in Cook Inlet or the refineries and Pacific Rim east markets (currently estimated at 38 per year). At any stopover points along this route, they also could be exposed to fuel spills from other vessels. Since the white-fronted geese follow similar routes north during spring migration, they would be exposed to similar risks from oil spills and other adverse factors (e.g., disturbance, habitat degradation).

In particular, stopover areas in Cook Inlet are subject to increasing disturbance from aircraft and recreational activities. Future operations on proposed State coal leases as well as current agricultural development on the west side of Cook Inlet could also result in increasing levels of goose disturbance and deterioration of water quality that may have long-term adverse impacts.

Adverse factors on the wintering grounds include harvests, disease, disturbance, and declines in habitat availability and/or quality resulting from changing patterns of land use. Fall hunting nearly all in California resulted in a harvest of approximately 14,000 white-fronted geese in 1985 (about 9% of the estimated winter population). Specific information which would quantitatively relate harvest, disturbance, disease, declining habitat availability or quality (e.g., reduced forage or water quality) in the wintering areas to declines in the white-fronted goose population is not available. Nor is sufficient harvest or environmental information available from Mexican wintering areas to allow specific projections of impact on the population to be made. However, if availability of suitable habitat continues to decline on the winter range (e.g., draining of wetlands), it can be expected that a corresponding decline in the white-fronted goose population may result in its increased vulnerability to the adverse factors discussed above.

Although white-fronted geese nest in a variety of habitats, they prefer elevated areas generally somewhat further inland, and with nests more dispersed, than other geese. This suggests that nesting adults or newly-hatched young would not be vulnerable to oil spills except in the case of strong onshore winds during high tides, or in the event of a storm surge. However, if an oil spill were to occur from late June to August when brood rearing, molting, and staging for migration takes place on lower elevation intertidal mudflats and sloughs, chances range from 10 to 100 percent that a substantial proportion of white-fronted goose breeding adults and young could be contacted, thereby, experiencing increased mortality and/or decreased recruitment for several years (Truett et al., 1984).

Residual oil from an oil spill deposited outside this period also could result in substantial oiling of geese. Estimated mean number of oil spills for Bering Sea Planning Areas (North Aleutian, St. George, Navarin, and Norton Basins, see Table IV.B.4-2) is 21; however, oil spill trajectory analysis Norton Sound Planning Area (DOI, MMS, 1985c) indicates that the probability of an oil spill contacting the Y-K Delta is 16 percent or less within 30 days. However, tankers servicing future Norton Basin platforms are likely to pass in the vicinity of the delta, thereby substantially increasing the risk of shoreline contact.

Likewise, there is negligible probability of an oil spill that originates in the North Aleutian Basin (one spill estimated) would contact white-fronted goose nesting areas on the Bristol Bay Lowlands. No onshore facility construction is contemplated in either area.

Migrants which make an intermediate stop in the northeastern Bristol Bay area (i.e., Naknek River to Cinder River, classified as State Critical Habitat Areas, staging area for about 25,000 white-fronted geese) could be exposed to an oil spill from the North Aleutian area; however, probability of oil spill occurrence and contact with these shoreline segments is negligible. Those geese (3,000 to 5,000) that stop in the

Upper Cook Inlet area could be exposed to oil spills originating in Lower Cook Inlet, Gulf of Alaska or Kodiak from existing leases (4 oil spills estimated).

Those geese stopping on the Copper River Delta State Critical Habitat Area and Bering River Delta could be exposed to oil spills from tankers transiting the west coast from the TAPS terminus in Valdez carrying oil from existing leases in the Beaufort Sea, as could those stopping on the Yakutat Forelands, Rocky Pass, and several points further south in coastal British Columbia, Washington, and Oregon. Use of the areas south of the Alaska Peninsula probably amounts to less than 5 percent of the total Pacific flyway population.

Since nearly all Pacific flyway white-fronted geese overwinter in California's Central Valley or other inland areas, activities associated with Federal offshore lease sales in this region are not likely to affect them significantly.

Since approximately 95 percent of the Pacific flyway white-fronted goose population nests on the Y-K Delta and overwinters in the Central Valley of California, factors in these two areas are likely to exert primary control over changes in distribution and abundance of this population. Factors acting on migrants stopping in northeastern Bristol Bay (approximately 15% of the population) could have some influence, and those acting elsewhere probably are insignificant since they involve only a small proportion of the population.

If provisions of the Y-K Delta Goose Management Plan are effective in maintaining this population above the prescribed management level, then impacts of most factors other than the current and future 5-year programs should remain at a low level. However, if habitat availability on the winter range continues to decline, or if subsistence/sport takes should increase substantially, long-term impacts on the population could be consistently elevated.

An oil spill originating from existing Federal leases could have moderate impacts if contact with the delta occurred under conditions that promoted its reaching elevated nesting habitat in May and June, and a high level of impact if it made contact from late June to August when both adults and young occupy low-lying tidal habitats that are vulnerable to virtually any oil spill. However, except for the possible grounding of a tanker in the vicinity of the delta, the probability of oil contact there appears extremely low.

The current and future 5-year programs suggest that development and production could increase in the future, and while overall impacts may not be elevated above moderate or high as discussed above, their certainty of occurrence may increase. If oil spills were to occur in more than one area visited by this population the level of impact might not be elevated significantly since the Y-K Delta is the primary area where oil spills could have a severe impact, most other areas being occupied by a relatively small proportion of the population (migration) or removed from contact by oil spills (winter).

CONCLUSION: The cumulative impacts to the white-fronted goose is expected to be moderate.

(b) Emperor Goose

The Y-K Delta emperor goose population recently has shown signs of stabilizing following an apparently steady decline (approximately 70%, accelerated in 1982-1986) from high population levels in the 1960's. The current Alaska spring population estimate (1988) is 53,800 (DOI, FWS, 1989b). Probable factors responsible for these trends include climatic variables, subsistence and sport hunting, egg gathering, and regulation of harvest activities.

On the delta breeding grounds, where 80-90 percent of the emperor population nests, important adverse factors include subsistence harvest of nesting geese and their eggs, and persistent ice and snowcover and/or flooding on nesting areas. Harvest in 1987 was 676 in spring (50% of total harvest) and 146 (11%) in early summer (Copp, 1987). Total harvest on the delta in 1987 (1352) 2.6 percent of the spring population count. Only 43 emperor eggs were estimated to have been taken on the delta. It is a substantial increase over the previous year. Harvest of both emperors and their eggs is prohibited by the Y-K Delta Goose Management Plan. Effects of current and potential disturbance factors on the delta are essentially as discussed above for the white-fronted goose.

Potential impacts associated with oil and gas production would result primarily from oiling of low elevation habitats, especially those regularly influenced by tides. Probability that an oil spill contacting the delta will reach grass/sedge meadows preferred by emperors for nesting (not flooded by ordinary tides

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but commonly flooded by storm surge) ranges from 10 to 100 percent. Likewise, there is a strong chance of oiling a substantial proportion of breeding adults and young on tide-influenced meadows and sloughs where brood rearing, molting and migration staging take place from late June to August.

Sources of an oil spill with the potential to affect emperors would be the same as those discussed for the white-fronted goose. The potential exists for small numbers of emperors nesting on Nunivak Island, St. Lawrence Island, along the northern coast of the Seward Peninsula, and near Kivalina north of Kotzebue to be contacted by an oil spill originating from existing leases in St. George/Navarin Basins and Chukchi Sea, respectively, but the probability of an oil spill occurring and contacting these areas is slight.

A molt migration of subadults and failed breeders to St. Lawrence Island occurs in June (DOI, FWS, 1989b). This may involve 10,000 to 20,000 individuals, but the probability of contact by oil spills originating from existing leases either in Norton or Navarin Basins is very low.

Following the nesting period and molt, emperor geese move to lagoons along the north side of the Alaska Peninsula from August to November (peak in September/October). Most lagoons receive some use by this species, but largest numbers are found most often in Nelson Lagoon (Port Moller), Seal Islands lagoon area (south of Port Heiden), Port Heiden, Cinder River delta and Izembek Lagoon (Dau, 1984; King and Derksen, 1983; Petersen and Gill, 1982).

This area could be exposed to oil spills from existing leases in the St. George Basin, and especially the North Aleutian Basin where possible transportation scenarios include the use of tankers in proximity to the Alaska Peninsula, or a pipeline coming ashore at Port Moller. Oil spills originating in the leased areas do not have a high probability (19 percent within 30 days) of shore contact (DOI, MMS, 1985a; and DOI, MMS, 1985b) but the presence of pipelines or tankers near the peninsula could substantially increase this risk.

Spills originating in a proposed State lease area that extends along this portion of the peninsula could enter streams and eventually lagoons and bays occupied by this and other species. Entry of oil into peninsula lagoons during spring or fall migration periods could have severe consequences for emperor geese, both in the short-term when increased mortality may result in decreased recruitment into the population, and long-term as a result of hydrocarbon retention and subsequent release in these relatively low-energy habitats. Of course the latter could occur whether geese were present initially or not.

Disturbance during construction of a pipeline across the peninsula could result in some minor stress and disruption of foraging patterns, but is likely to have only short-term consequences. Emperor geese staging prior to migration in Izembek Lagoon, however, could experience elevated levels of disturbance from aircraft operation as a result of its proximity to the Cold Bay airport favored as an air-support facility for the North Aleutian lease area. Potential impacts during spring migration (March to early June, peak in March/April) would be similar to fall since the same areas are utilized.

Emperor geese overwinter throughout the Aleutian Islands and east to the Kodiak Island area. Although there are no leases adjacent to the Aleutians, oil spill trajectories from the St. George Basin suggest that most if not all of the islands could be contacted by a large oil spill in this season. However, unless drilling commences on St. George Basin leases, most winter mortality in the former area is likely to result from non-OCS causes. In the fall season, only the easternmost islands are likely to be contacted. As a result of currents circulating from east to west in the Gulf of Alaska, that segment of the population wintering further east could be exposed to oil spills from tankers serving the Valdez terminus of TAPS or refineries in Cook Inlet, or originating from Cook Inlet platforms on State leases.

As discussed above, emperor geese preferentially nest in loose colonies on grass/sedge meadows on the outermost portion of the delta commonly flooded by very high tides and storm surge. In addition, brood rearing, molting, and preparation for migration also take place in low elevation habitats, thereby, exposing large numbers of emperors to oiling, particularly if an oil spill were to contact the delta during the period May through August. Residual oil from an oil spill deposited outside this period also could result in substantial oiling of geese. Twenty-one oil spills are estimated for lease areas in the vicinity of the Y-K Delta (Norton, Navarin, St. George, North Aleutian) from the current and future 5-year programs. Oil spill trajectory analysis Norton Sound Planning Area) (DOI, MMS, 1985c) indicates that the probability of oil spills contacting the delta is 16 percent or less within 30 days.

Passage near the delta of tankers servicing Norton Basin platforms could increase substantially the risk of shoreline contact. Relatively small numbers of nesting and post-nesting emperors occupying scattered

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sites as noted above could be affected by oil spills originating in Chukchi Sea, Hope, Norton, Navarin, St. George, and North Aleutian Basins (29 oil spills estimated, see Table IV.B.4-2), but the probability of an oil spill contacting these areas is very low. Likewise, emperors gathering at St. Lawrence Island following molt migration in June are not at high risk from oil spills originating in lease areas.

As discussed above, emperor geese staging in lagoons along the north shore of the Alaska Peninsula could be exposed to oil spills originating primarily in the North Aleutian Basin (one oil spill estimated), although probability of occurrence and contact along this coast based on existing oil spill analysis is 6 percent or less. Transportation scenarios involving a pipeline to shore or offshore loading to tankers could increase the risk of released oil entering these lagoons significantly by moving the potential spillpoint closer to land. Impacts of disturbance resulting from construction of a pipeline or increased air traffic out of the regional airport at Cold Bay would be similar to those described in the previous section.

Likewise, impacts on emperor geese wintering in the Aleutian Islands would be similar to those described above. Birds wintering in the Kodiak Island-Alaska Peninsula area could be exposed to a total of five oil spills estimated for Gulf of Alaska, Cook Inlet, Kodiak and Shumagin Planning Areas combined, and in addition, to oil spills from tankers transiting the west coast from the TAPS terminus in Valdez carrying oil from Beaufort lease areas.

Since most of the emperor goose population is concentrated seasonally in three areas (Y-K Delta, nesting; Alaska Peninsula lagoons, staging; Aleutian Islands-Kodiak Island, wintering), factors in these areas are likely to exert primary control over changes in distribution and abundance of this population. Elsewhere in Alaska, a relatively small proportion of the population is at risk.

If provisions of the Y-K Delta Goose Management Plan are effective in returning this population to and maintaining it above the prescribed management level, then effects of most factors other than the current and future 5-year programs should remain at a low level. However, if habitat availability on the winter range continues to decline, or subsistence/sport harvest should increase substantially, long-term impacts on the population could be consistently elevated.

An oil spill originating from a existing Federal leases could have moderate impacts if contact with the delta occurred under conditions that promoted its reaching nesting habitat in May and June, or a relatively limited proportion of staging or winter habitat. High impacts could result if an oil spill contacted the delta from late June through August when both adults and young occupy low-lying tidal habitats that are vulnerable to virtually any oil spill. Likewise, high impacts could result from oil spill contact with a substantial proportion of staging or wintering habitat. However, except for a tanker spill in the vicinity of the delta, a pipeline or tanker spill in the vicinity of the Alaska Peninsula, or a large oil spill in the vicinity of the Aleutians, the probability of oil contact with theses areas is low to negligible.

The current and future 5-year programs suggest that Federal oil and gas development and production could increase in the future, and while overall impacts may not be elevated above moderate or high as discussed above, their certainty of occurrence may increase. The potential for a high level of impact is increased as a result of emperor geese concentrating in lagoons along the Alaska Peninsula during their migration, because more geese may be exposed to any single oil spill. A range of 8 to 11 oil spills from all sources (Table IV.B.4-2) are estimated to occur within the five planning areas north and south of the Alaska Peninsula. It is estimated that 4 to 6 of these spills may be related to the current and future 5-year programs.

Given the oil spill estimates presented above, it is reasonable to assume that a major oil spill will occur, enter some of the lagoons where emperor geese stage for migration, and contact some of the local goose population while they are on the water. These oiled geese are likely to suffer a high mortality rate from drowning or hypothermia, some geese will become sick and later die from ingesting oil and/or inhaling toxic fumes, and some with lightly oiled feathers could possibly survive. It is highly unlikely that any single oil spill would contact all of the emperor geese or their habitat along the Alaska Peninsula simultaneously. As noted above, there is about a 15 to 20 percent chance of an oil spill contacting the Alaska Peninsula and a lesser possibility of occurring during a critical migration period, entering a coastal lagoon, and contacting geese on the water. Therefore, the current and future 5-year programs are not expected to substantially increase the existing moderate cumulative impact on emperor geese.

CONCLUSION: The cumulative impacts on the emperor goose is expected to be moderate.

(c) Cackling Canada Goose

The Y-K Delta cackling Canada goose population recently has exhibited signs of stabilizing following a massive decline (95%) from high population levels in the 1960's. The fall 1988 population estimate is 69,900 (DOI, FWS, 1989c). Probable factors responsible for these trends include climatic variables, subsistence and sport hunting, egg gathering, predation, winter habitat availability/quality, and regulation of harvest activities.

On the delta breeding grounds, where over 90 percent of the cackling Canada goose population nests, important adverse factors include subsistence harvest of nesting geese and their eggs, persistent ice/snowcover and/or flooding on nesting areas, and predation. Harvest in 1987 was 2,003 in spring (62% of total harvest) and 293 (9%) in early summer (Copp, 1987). Total harvest on the delta (3,218) was 4.6 percent of the fall population estimate. About 194 cackler eggs were estimated to have been taken on the delta. This is a substantial increase over the previous year. Harvest of both cacklers and their eggs is prohibited by the Y-K Delta Goose Management Plan. Impacts of current and potential disturbance factors on the delta are essentially as discussed above for the white-fronted goose.

Potential impacts associated with oil and gas production would result primarily from oiling of low elevation grass/sedge meadow habitat near the delta fringe preferred by cacklers for nesting. Although this habitat is not flooded by ordinary tides, under storm surge conditions there is high probability that it would be affected by any oil contacting the delta. Where tide-influenced habitats are utilized for brood rearing and molting, both adults and young would be at risk. Sources of an oil spill with the potential to affect cacklers would be the same as discussed for the white-fronted goose.

By mid to late August, following the nesting period and molt, cacklers gradually move to staging areas on the north side of the Alaska Peninsula, primarily Pilot Point in Ugashik Bay and the Cinder River delta. These areas could be exposed to oil spills from existing leases in the St. George Basin or North Aleutian Basin, but the probability of contact is extremely low. However, if tankers servicing these areas were to enter the nearshore zone the risk could be increased substantially. Entry of oil into primary staging areas along the peninsula during spring or fall migration periods could have severe consequences for cackling Canada geese, both in the short-term when increased mortality may result in decreased recruitment into the population, and in the long-term as a result of hydrocarbon retention and subsequent release in these relatively low-energy habitats.

The current level of disturbance and its impact on geese in the staging areas has not been quantified, but it is likely to increase over the next several decades and potentially could become a significant factor, especially if expansion of human activities results in decreased availability of suitable habitat.

In mid-October cacklers proceed directly from the Alaska Peninsula to intermediate stopover areas in Oregon (Willamette Valley) and northern California (Klamath Basin). By December a majority are on the primary wintering grounds in the Central Valley of California. Since hunting currently is prohibited, the greatest threats to cacklers in this area are the declining availability of suitable habitat and increasing level of disturbance.

Quantitative information relating these factors to declines in the cackler population is not available, but it is likely that continued habitat loss would contribute to such a trend. During spring migration cacklers return to the Y-K Delta by way of marshes in Upper Cook Inlet, as well as tidelands in Southeast Alaska, Copper/Bering River Deltas and Prince William Sound. In these areas geese could be exposed to oil spills from tankers serving the TAPS or Kenai Peninsula refineries. In Cook Inlet, oil spills originating from State lease areas could affect spring migrants, and at any stopover points they could be exposed to fuel spills from other vessels as well as increasing levels of disturbance from aircraft and recreational activities. In addition, future operations on proposed State coal leases as well as current agricultural development on the west side of Cook Inlet could result in increasing levels of goose disturbance and deterioration of water quality that may have long-term adverse impacts.

Like the other goose species nesting on the outer coast of the Y-K Delta, cacklers are vulnerable to oiling by oil spills which contact the coastline. Vulnerability of cacklers probably is more similar to the white-fronted than the emperor goose since they commonly nest in the more elevated grass/shrub transition zone which is seldom flooded. Details of the potential oil spill risk and impacts to which cacklers may be exposed while on the delta are discussed under the same topic for white-fronted and emperor geese. Likewise, potential risks and impacts of oil spills in the vicinity of Alaska Peninsula staging areas in fall and Gulf of Alaska and especially Upper Cook Inlet staging areas in spring (10,000+ individuals) would be essentially as described for the white-fronted goose and in the previous section. Since nearly all cacklers overwinter in California's Central Valley, activities associated with Federal offshore lease sales in this region are not likely to affect them significantly.

If provisions of the Y-K Delta Goose Management Plan are effective in returning the cackling Canada goose population to and maintaining it above the prescribed management level, then impacts of most factors other than Federal lease sales included in the current and future 5-year programs should remain at a low level. However, if habitat availability on the winter range continues to decline, or subsistence/sport harvest should increase substantially, long-term impacts on the population could be consistently elevated.

An oil spill originating from a existing Federal leases could have moderate impacts if contact with the delta occurred under conditions that promoted its reaching nesting habitat in May and June, or a relatively limited proportion of staging or winter habitat. High impacts could result if an oil spill contacted the delta from late June through August when many adults and young occupy low-lying tidal habitats that are vulnerable. Likewise, high impacts could result from oil spill contact with a substantial proportion of the habitat occupied by staging geese on the Alaska Peninsula. However, except for a tanker spill in the vicinity of the delta or peninsula, the probability of oil contact with these areas is low to negligible.

The current and future 5-year programs suggests that Federal oil and gas development and production could increase in the future, and while overall impacts may not be elevated above moderate or high as discussed above, their certainty of occurrence may increase. The potential for a high level of impact is increased as a result of cackling Canada geese concentrating in lagoons along the Alaska Peninsula during their migration, because more geese may be exposed to any single oil spill. A range of 8 to 11 oil spills from all sources (Table IV.B.4-2) are estimated to occur within the five planning areas north and south of the Alaska Peninsula. It is estimated that 4 to 6 of these spills may be related to the current and future 5-year programs.

Given the oil spill estimates presented above, it is reasonable to assume that a major oil spill will occur, enter some of the lagoons where cackling Canada geese stage for migration, and contact some of the local goose population while they are on the water. These oiled geese are likely to suffer a high mortality rate from drowning or hypothermia, some geese will become sick and later die from ingesting oil and/or inhaling toxic fumes, and some with lightly oiled feathers could possibly survive. It is highly unlikely that any single oil spill would contact all of the cackling Canada geese or their habitat along the Alaska Peninsula simultaneously. As noted above, there is about a 15 to 20 percent chance of an oil spill contacting the Alaska Peninsula and a lesser possibility of occurring during a critical migration period, entering a coastal lagoon, and contacting geese on the water. Therefore, the current and future 5-year programs are not expected to substantially increase the existing moderate cumulative impact on cackling Canada geese.

CONCLUSION: The cumulative impacts on the cackling Canada goose are expected to be moderate.

(d) Pacific Black Brant

Although the Pacific flyway population of the Pacific black brant has not exhibited the marked declines typical of other species, there have been significant changes in seasonal distribution as well as a general downward trend from high population levels of the 1960's (approximately 30%). The current midwinter population estimate is 138,000 (DOI, FWS, 1989d). Probable factors responsible for these trends include climatic variables, subsistence and sport hunting, egg gathering, predation, and regulation of harvest activities. Major distributional changes have occurred in both wintering and breeding ranges. Prior to 1960, about 54,000 brant wintered along the coast of Washington, Oregon, and California; in recent years this number has declined to about 10,000 with a corresponding increase in the numbers overwintering in Mexico. On the Y-K Delta breeding grounds, much formerly-utilized habitat remains vacant; from 1981 to 1986 numbers of brant breeding in three censused areas declined from about 22,000 to 8,000 (62%). Evidently, the breeding activity of a substantial proportion of the black brant population has shifted to other northern localities.

On the delta breeding ground, where now less than 20 percent of the brant population nests, important adverse factors include persistent ice and snowcover and/or flooding of nesting areas, predation, and subsistence harvest of nesting geese and their eggs. In arctic breeding areas, currently climatic factors and predation are most important. Harvest in 1987, was 383 in spring (37% of total harvest) and 244 (24%)

in early summer (Copp, 1987). Total harvest on the delta in 1987 (1030) represented about 1 percent of the winter population estimate. Egg gathering on the delta (134) declined from the previous year.

Although general impacts of current and potential disturbance factors are essentially as discussed previously for the white-fronted goose, it is evident from recent studies that brant are the most easily and severely disturbed species of the four considered (Ward et al., 1988). Predation also appears to be a more severe problem for brant than the other species. In large concentrations, the brant's colonial nesting habit is advantageous by swamping predators; in the smaller colonies that now exist on the delta, this impact is reduced and may result in greater predator efficiency. The brant's inability to defend its nest may intensify this impact. Almost complete nesting failure due to predation was documented at one colony studied in 1985.

Potential impacts associated with oil and gas production would result primarily from oiling of low elevation grass/sedge meadow and elevated intertidal mudflat habitats at the outermost fringe of the delta preferred by brant both for nesting and brood rearing. By nesting in habitats in or close to the tidal zone brant expose their nests to tidal flooding, and thus to oiling from oil spills transported by high tides or storm surge. Later in the summer molting adults and young would be at risk in these same habitats. Sources of an oil spill with the potential to affect brant would be the same as discussed for the white-fronted goose.

A migration of as much as 20 percent (10,000 to 20,000) of the brant population to the Teshekpuk Lake-Cape Halkett area on Alaska's arctic slope takes place in late June and July. Here they molt and then join brant that have nested on the slope and their young in Beaufort Sea coastal lagoons. In August and September, these post-molting and post-breeding birds migrate westward along the Beaufort coast and southward along the Chukchi and Bering Sea coasts, stopping frequently in lagoons to rest and feed, until they join the remainder of the brant population staging from September to November at Izembek Lagoon on the north side of the Alaska Peninsula (Truett, 1983).

This segment of the population could be exposed to both oil spills and disturbance from activity associated with State and Federal leases along the Beaufort Sea coast, and with Federal leases along the Chukchi and Bering Sea coasts. Since nearly all Pacific black brant stage in Izembek Lagoon, an oil spill entering this area poses the greatest risk to the population on its northern range. Potential sources of oil spills, their probability of occurrence and contact, and possible consequences in this area are as discussed for the emperor goose above. In addition to the direct impacts of oil exposure, brant, as a result of their restricted diet, are extremely vulnerable to reduced forage that may result from oiling of eelgrass, their primary food source.

Brant could experience elevated levels of disturbance from aircraft operation as a result of the proximity of Izembek to the Cold Bay airport favored as an air-support facility for the North Aleutian lease area. Although brant obviously are greatly disturbed by aircraft overflights of the lagoon, as well as other types of human activity, no definite correlation between disturbance and their ability to store adequate energy reserves for continued migration or reproduction has been proven (DOI, MMS, 1985). Disturbance does reduce brant foraging efficiency (Derksen et al., 1979). Brant utilize many of the same lagoons on their northward migration in April and May, particularly Izembek Lagoon, thus potential adverse impacts are likely to be similar to those discussed above.

Over 90 percent of the brant population winters along the coasts of Baja California and mainland Mexico, most flying there directly from Izembek. The remainder (7.5%) winter along the west coast from California to British Columbia, although this number has declined. Several thousand may remain at Izembek, especially in mild winters. It is evident that if recent trends in the number of brant wintering in these areas is an indication, a declining proportion of the population is likely to be affected by oil and gas development activity, disturbance from various other human activities, habitat reduction, changes in water quality, and hunting in the future. Potential impacts of adverse factors that may affect the bulk of the population wintering in Mexico are unknown at present, but are likely to include many of those discussed above as the development of coastal western Mexico proceeds.

Because of their habit of nesting on the extreme outer fringe of the Y-K Delta, brant are vulnerable to oiling by virtually any oil spill which contacts the coastline. Likewise, post-molt and post-breeding brant resting and foraging in coastal areas in northern and western Alaska while in migration to Izembek Lagoon are extremely vulnerable to oil spills (19 estimated for all activities associated with lease areas adjacent to this migration corridor). Details of the potential oil spill risk and impacts to which brant may be exposed while occupying these areas are discussed under the same topic for white-fronted and emperor geese, as well as in the previous section.

Similarly, potential risks and impacts of oil spills and disturbance in the vicinity of Alaska Peninsula staging areas in spring and fall would be essentially as described for the emperor and cackling Canada geese, and in the previous section above. Since nearly all brant overwinter along coastal western Mexico, only the relatively small proportion (7.5%) of the population wintering further north along the west coast are likely to be affected by activities associated with future federal offshore lease sales.

If provisions of the Y-K Delta Goose Management Plan are effective in maintaining the brant population above the prescribed management level, then impacts of most factors other than Federal lease sales included in the current and future 5-year programs should remain at a low level. However, if habitat availability/quality on the winter range were to decline, or substantial increases in level of disturbance at Izembek Lagoon or subsistence/sport harvest were to occur, long-term impacts on the population could be consistently elevated.

An oil spill originating from existing Federal leases could have moderate impacts if contact with the delta occurred under conditions that promoted its reaching nesting habitat in May and June, if an oil spill entered Beaufort Sea coastal areas prior to the point at which both post-molt and post-breeding adults and their young are present in substantial numbers, or if a relatively limited proportion of winter habitat were contacted by an oil or fuel spill.

High level of impact could result if an oil spill contacted the delta from late June through August when many adults and young occupy low-lying tidal habitats that are vulnerable, or important staging areas along the Beaufort Sea coast from mid to late summer, or a limited portion of Alaska Peninsula staging habitat were contacted. Very high impacts could result from oil spill contact with a substantial proportion of the habitat occupied by staging geese on the Alaska Peninsula. However, except for a tanker spill in the vicinity of the delta or peninsula, or platform/pipeline spill in the Beaufort or Chukchi Sea, the probability of oil contact with most of the coastline in these areas is low to negligible.

The current and future 5-year programs suggest that Federal oil and gas development and production could increase in the future, and while overall impacts may not be elevated above moderate or high as discussed above, their certainty of occurrence may increase. The potential for a high level of impact is increased as a result of black brant concentrating in lagoons along the Alaska Peninsula during their migration, because more geese may be exposed to any single oil spill. A range of 8 to 11 oil spills from all sources (Table IV.B.4-2) are estimated to occur within the five planning areas north and south of the Alaska Peninsula. It is estimated that 4 to 6 of these spills may be related to the current and future 5-year programs.

Given the oil spill estimates presented above, it is reasonable to assume that a major oil spill will occur, enter some of the lagoons where black brant stage for migration, and contact some of the local goose population while they are on the water. These oiled geese are likely to suffer a high mortality rate from drowning or hypothermia, some geese will become sick and later die from ingesting oil and/or inhaling toxic fumes, and some with lightly oiled feathers could possibly survive. It is highly unlikely that any single oil spill would contact all of the black brant or their habitat along the Alaska Peninsula simultaneously. As noted above, there is about a 15 to 20 percent chance of an oil spill contacting the Alaska Peninsula and a lesser possibility of occurring during a critical migration period, entering a coastal lagoon, and contacting geese on the water. Therefore, the current and future 5-year programs are not expected to substantially increase the existing moderate cumulative impact on black brant.

CONCLUSION: The cumulative impacts on the Pacific black brant are expected to be moderate.

(e) Other geese

Five of the remaining geese have restricted breeding and/or wintering ranges. The few thousand tule geese nest in Redoubt Bay, Cook Inlet, and winter in three small areas of California. This race of white-fronted goose has been proposed for addition to the List of Endangered and Threatened Wildlife. Dusky Canada geese, population 10,000 to 15,000 and declining, nest primarily on the Copper River Delta and winter in eastern Oregon. Most Vancouver Canada geese, population 40,000 to 50,000, nest and winter in southeast Alaska. The few thousand lesser Canada geese nest in the Cook Inlet area. Lesser snow geese, population about 40,000, nest on Wrangel Island off Siberia and winter in California's

Central Valley. Taverner's Canada geese, population about 100,000, breed in interior Alaska and on the Y-K Delta and winter in the Columbia River Basin in Washington and Oregon, and in central California.

In their extremely restricted breeding area, tule geese and lesser Canada geese could be vulnerable to oil spills from tankers serving the TAPS terminus in Valdez or Kenai Peninsula refineries, production platforms in Cook Inlet, or fuel spills from other vessels. Dusky Canada geese, also restricted in breeding range, could be vulnerable to oil spills from tankers serving TAPS or fuel spills from other vessels. In recent decades they have experienced extremely poor reproductive success, primarily as a result of high rates of predation, but also frequently from unfavorable weather early in the breeding season.

Likewise, Vancouver Canada geese could be exposed to oil spills from tankers serving TAPS, or fuel spills throughout the year. Lesser snow geese could be vulnerable to oil spills during spring staging in Cook Inlet, fall staging on St. Lawrence Island, Seward Peninsula, the Yukon Delta and in Ugashik Bay. Taverner's Canada geese could be exposed to oil spills and increased disturbance primarily during fall staging at Izembek Lagoon on the Alaska Peninsula. On the breeding, staging, and especially on the wintering grounds, declining availability/quality of suitable habitat and increasing disturbance from human activities are likely to have adverse impacts on all of these species of geese.

The current and future 5-year programs suggest that oil and gas development and production could increase in the future, thereby elevating the oil spill risk to which all of these species would be exposed. Tule geese, lesser Canada geese, and lesser snow geese could be affected by oil spills from Cook Inlet, Gulf of Alaska, or Kodiak lease areas. Dusky and Vancouver Canada geese could be affected by oil spills from the Gulf of Alaska lease area or tankers serving TAPS. Taverner's Canada geese could be affected by an oil spill from the North Aleutian Basin.

Impacts on the tule goose potentially could be high from adverse factors other than the current and future 5-year programs, very high as a result of its nesting in a restricted area vulnerable to oil spills from several lease areas and other sources. Likewise, dusky Canada geese, and perhaps lesser, currently approach high impacts from non-OCS factors; oil spills could make this level of impact occur with greater certainty. Vancouver Canada geese could experience moderate impacts from oil spills. Lesser snow geese could experience moderate impacts from oil spills. Taverner's Canada geese could experience moderate to high impacts if an oil spill were to enter Izembek Lagoon when they are concentrated here during fall staging.

CONCLUSION: The cumulative impacts on other goose species are expected to be moderate.

(2) Diving Ducks

Of the 18 species of diving ducks that breed in Alaska, oldsquaw and common and king eiders are the most abundant to occur in Beaufort, Chukchi, and Bering Sea coastal habitats. During migration and/or molting periods perhaps 500,000 oldsquaw, several hundred thousand common eiders, and one million or more king eiders utilize these coastlines. Bering Sea coastal habitats also are occupied by perhaps one million scoters, Steller's eiders, scaup, and other diving ducks during these periods, and substantial numbers of several species are found seasonally as far south as the Pacific northwest and California.

Activities that could produce significant adverse impacts in diving duck populations include oil and gas development on current Federal leases in the Bering, Chukchi, and Beaufort Seas; current and future State oil and gas leases in Beaufort and Bering Sea areas and Cook Inlet; onshore Federal oil and gas development (including ANWR); the TAPS; Canadian Beaufort production; increasing levels of disturbance from operation of aircraft, boats and vehicles and other human activity in areas where ducks are engaged in activities that make them particularly sensitive; expansion of residential and recreational land use; subsistence harvest of birds and their eggs; and sport harvest.

Persistent ice and snowcover and/or flooding of nesting areas, severe weather during spring migration, predation, decreased food availability during critical foraging periods, and declining water quality also can result in adverse impacts.

The oldsquaw is the most abundant breeding duck on the arctic coastal plain (Truett, 1983), possibly numbering 100,000 to 200,000, but substantial numbers of several other species, including Steller's and spectacled eider, also nest here and, thus, also could be exposed to oil spills from current and future state and Federal onshore lease areas, as well as TAPS, particularly if oil spills were to spread along major watercourses. Disturbance associated with petroleum development on the coastal plain could displace nesting waterfowl from preferred habitat, although there is evidence that oldsquaw do not readily abandon areas subjected to short-term intermittent disturbance (Johnson and Richardson, 1981; Johnson, 1982).

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Fox predation on common eiders nesting on barrier islands along Beaufort and Chukchi Sea coasts is a major cause of breeding failure in this species; disturbance causing them to abandon secure islands could have adverse impacts on productivity. Any of the nesting species could be affected adversely by other factors noted above such as persistence of unfavorable nesting conditions in early summer, elevated or concentrated predator populations, elevated levels of disturbance in the breeding area (from recreational or industrial activity), decreased water quality, and increased harvests.

Waterfowl populations are most vulnerable when they occupy limited coastal aquatic habitats during the molting or migration periods. During the post-breeding molt period, which extends from mid-July to mid-August, as many as a half-million oldsquaws, together with large numbers of other tundra-nesting species, may occupy Beaufort Sea lagoons and bays. Beginning in early July, hundreds of thousands of molt-migrant king eiders and tens of thousands of common eiders (males and nonbreeding birds) move westward along the Beaufort Sea coast primarily from Canadian breeding grounds; however, apparently few stop for any length of time until reaching molting areas along Chukchi and Bering Sea coasts. In late July broods of common eiders also move from the barrier islands to the lagoons. By mid-August, most oldsquaw males and nonbreeders have departed, and in September females with their young begin the southward migration. Although many eastbound spring migrants follow the Beaufort coastline in May and June (Flock, 1973), they are commonly recorded well inland and offshore (Divoky, 1983). For example, most common and king eiders appear to follow leads in the pack ice far offshore (40 km recorded); likewise, oldsquaws follow various routes but those near the coast frequently stop in the open water at river mouths to feed (since water is frozen elsewhere), joining coastal migrant eiders. Unseasonably cool weather occasionally may result in high mortality in king eiders and other species. Barry (1968) estimated that 100,000 king eiders died of starvation in 1964 as a result of a late thaw in the Beaufort Sea area.

The fact that spring migrants are strongly attracted to the limited open water available suggests both that large numbers could succumb in any large oil-contaminated lead, and that they might be attracted to oil on the ice surface (its dark appearance suggesting open water; Johnson and Richardson, 1981). It is evident that the potential oil spill risk to these species, especially oldsquaws, is high during migration and molt periods. Oil spills could originate onshore and follow major rivers into the lagoons, or at nearshore/offshore platforms or pipelines. The large numbers of eiders and oldsquaws that nest on the Canadian coastal plain also could be at risk from oil spills in the Canadian Beaufort. Overall, however, oil spill impacts are not likely to exceed a moderate level, because of the large regional population of these species and their substantial reproductive potential, except oldsquaws exposed to more than one oil spill in areas of concentration within relatively short periods (1 or 2 generations) could experience high impacts.

Seasonal use of the Chukchi Sea coastal area is similar to that of the Beaufort in that most eiders (about 1 million king, 10's of thousands common) and oldsquaws (several 100 thousand) pass through during spring and fall migration, substantial numbers molt in coastal lagoons, and a relatively small proportion of their populations actually nest in the area. Spring migration occurs from about mid-May to mid-June over a broad front with coastal, offshore, and inland routes used by various species. To a great extent the timing of migration varies with the wind direction and corresponding availability of open water (Divoky, 1983). A prominent and recurring offshore lead system extends between Pt. Hope and Pt. Barrow that is followed by most migrating waterfowl, and others probably are followed north from the Bering Strait. Strong headwinds of refreezing/closing of leads can retard their progress and cause them to be concentrated in remaining open water. Once conditions improve, they may proceed long distances nonstop. For example an estimated 500,000 king eiders may have flown over 480 km from Cape Lisburne area to Pt. Barrow in a single day (Woodby and Divoky, 1982).

In the northern Chukchi Sea area, a few thousand common eiders nest in colonies along barrier islands of Kasegaluk Lagoon. In early July, 100's of thousands of molt-migrant king eiders (mostly males) return along the coast; by mid-August, females and juveniles begin to predominate (Lehnhausen and Quinlan, 1981). Flocks are present in the lagoon and Peard Bay and in nearshore waters off Pt. Lay and in Ledyard Bay after midsummer and large-scale movements begin in late July, continuing until early October. Some remain until mid-November as long as open water persists. South of Cape Lisburne, migrants proceed farther offshore (Springer et al., 1982). In late June soon after spring migration has ceased, there is a substantial northward movement of molt-migrant oldsquaws from more southerly areas. Large numbers of these molting birds are present in lagoons and along barrier islands, especially in Kasegaluk Lagoon and Peard Bay, from mid-July until late August. Fall migration is underway by early September and large flocks of hundreds or thousands may stop in the nearshore zone to rest and feed (Timson, 1976). Few remain after mid-October.

Oil spills may originate from platforms or pipelines in the Chukchi Sea lease area (probability of shore contact within 30 days in summer ranges up to 77%). Areas judged most vulnerable include: the spring lead system where extremely large numbers of migrating eiders and oldsquaws are concentrated; nearshore waters and lagoons from Cape Lisburne to Pt. Barrow in summer, which includes common eider breeding colonies and concentrations of 10's to 100's of thousands of molting eiders and oldsquaws; and these areas in fall when large numbers of migrant eiders and oldsquaws frequently stop to rest and feed (Roseneau and Herter, 1984). Likewise, in Kotzebue Sound open leads in spring and coastal areas in summer and fall are important habitats vulnerable to oil spills of tanker origin. Impacts of oil spills experienced by these three species could range from a moderate (single oil spill exposure) to a high (multiple oil spill exposure) level, for although each has a large regional population with substantial reproductive potential, large proportions of their respective regional populations are concentrated seasonally in vulnerable coastal areas. Among natural adverse factors, the occurrence of unseasonably severe weather during spring migration probably has the greatest potential for causing high mortality.

Although most of these three species' regional populations winter further south, an estimated 50,000 eiders and as many as 500,000 oldsquaws (Fay, 1961) typically remain in open water near St. Lawrence Island; smaller numbers winter in the vicinity of St. Matthew Island and Nunivak Island, as well as other openings in the seasonal pack ice. Probability of oil spill occurring in a lease area and contacting these areas generally is low; however, contact by an oil spill of tanker origin could occur, and in the case of St. Lawrence Island potentially result in high impacts if the highest estimates of oldsquaw abundance prevail, moderate if the number is closer to 100,000.

On the Y-K Delta, common nesting species include common and spectacled eiders, greater scaup, black scoter, oldsquaw and Barrow's goldeneye. Primarily eiders, especially spectacled, nest at sufficiently low elevation for occasional flooding (and potential oiling) during storm surges. Only during spring migration and the midsummer molting and brood rearing period are large concentrations of diving ducks at risk. In spring, as open water becomes available near the delta, large numbers of common and king eiders and oldsquaw, together with smaller numbers of Steller's eider and other species. Molting of male, subadult and nonbreeding eiders and oldsquaws occurs in the delta nearshore zone (and elsewhere in coastal Alaska) in July and August. A recently documented molt-migration of all three species of scoter, apparently including birds from other breeding areas, concentrates tens of thousands in the nearshore zone of the Y-K Delta, as well as other areas from Kotzebue Sound to Cook Inlet, in July and August. During these periods when diving ducks are concentrated, contact of the area by an oil spill, unlikely unless originating from a tanker, could result in moderate impacts.

Along the Alaska Peninsula several embayments, particularly Nelson and Izembek Lagoons, are of primary importance to migrating populations of diving ducks, but some provide wintering habitat as well. In spring king eiders move from their wintering areas (Bristol Bay, the Aleutian Islands, and adjacent southern Bering Sea, east to Kodiak Island) to congregate in large rafts (10,000 to 50,000; one estimated at 300,000) in bays and lagoons of the peninsula (Gill et al., 1978). Similar movements are undertaken by common eiders from wintering areas in the Gulf of Alaska, Aleutian Islands, and southern Bering Sea. Steller's eiders occur in large flocks during spring and fall migration periods in lagoons of Bristol Bay and Alaska Peninsula (Troy and Johnson, 1987). Up to 100,000, mainly males, molt in Nelson Lagoon from early August to late September. Females molt primarily in Izembek Lagoon. Following the molt, Steller's eiders move to wintering areas in the eastern Aleutians, Alaska Peninsula and east to Kodiak Island and Lower Cook Inlet. Spring migration involves a gradual return to the peninsula where they remain through early May. Migration apparently proceeds to Nelson Lagoon, Cape Peirce, Dall Point, St. Lawrence Island and Siberia, with small numbers following the Alaskan coast to the arctic slope. Risk to this population on its Siberian nesting areas is unknown.

Black scoters breed on coastal tundra, surf and white-winged in the interior of Alaska. Following their molt-migration to coastal areas large numbers of migrant black scoters (720,000 reported by Gill et al., 1981), as well as greater scaup, are found in Nelson Lagoon on the Alaska Peninsula. Most scoters winter in more southern areas along the Pacific coast to California, but several hundred thousand winter in the eastern Aleutians and south Alaska Peninsula, east to Kodiak Island, Lower Cook Inlet, and Prince William Sound where tens of thousands of white-winged and surf scoters have been reported (Arneson, 1980). Populations of any of these species wintering in the Gulf of Alaska area or along the west coast could be at risk from oil spills originating from tankers serving the TAPS terminus in Valdez. Estimated numbers in the Bering Sea and percent of North American population are: black, 489,000 (50%); surf, 116,000 (25%); white-winged, 401,000 (33%) (King and Dau, 1981). The 1987 subsistence harvest of black scoters was 5,987 (Copp, 1987). Spring migration through Bristol Bay occurs in late April. Of the many species wintering in the Kodiak Island area, oldsquaw (65,000), white-winged (35,000), black scoters (26,000) and harlequin duck (9,600) are the most numerous (Forsell and Gould, 1981). Across the Gulf of Alaska, in the Yakutat Bay area, white-winged and surf scoters are the most numerous species (Patten, 1981). Wintering populations of these two species occur all along the Pacific coast, and they are the most abundant waterfowl species off California. In most of the areas noted above, an oil spill is likely to have low to moderate impacts; however, if an oil spill were to enter Nelson Lagoon or Izembek Lagoon during migration, high impacts could result.

The highly migratory nature of most diving ducks suggests that during their annual cycle they will move through several OCS planning areas, and nest and overwinter in others, thereby potentially exposing their populations to multiple oil spills and other adverse factors associated with oil and gas development. Exposure of diving ducks to multiple oil spills under the current schedule is possible since leases are held in several planning areas; however, the present rate of development does not suggest that this is likely except potentially in the Beaufort Sea. Presumably, multiple oil spills are more likely with the addition of the current and future 5-year programs because of the inclusion of all Alaska planning areas as well as those adjacent to Washington, Oregon, and California. A multiple-spill scenario occurring within the equivalent of two generations would elevate projected impacts, or result in their occurrence with greater certainty.

Oldsquaws are most vulnerable when concentrated during the post-breeding molt and migration in Beaufort Sea lagoons from July to September and in Chukchi Sea lagoons from July to October, in the Chukchi Sea spring lead system in May and June, and in the St. Lawrence Island polynya in winter. Oldsquaws occupying these areas could experience high impacts from oil spills, while those occupying offshore leads and river mouths in the Beaufort Sea and leads and other open water in the Bering Sea in spring, coastal areas of the Y-K Delta and Alaska Peninsula in spring and fall, and wintering areas where this species concentrates (e.g., Aleutians and Gulf of Alaska) could be subject to moderate impacts. Low impacts are more likely from oil spills and disturbance on the arctic coastal plain nesting area, and in the southern wintering range, southeast Alaska to California, where distribution is more sparse. Approximately 44 oil spills are estimated with the addition of the current and future 5-year programs within the range where oldsquaws are seasonally abundant (Beaufort Sea to Gulf of Alaska).

King and common eiders are most vulnerable when concentrated during post-breeding molt and migration in Chukchi Sea lagoons from July until October, in the Chukchi Sea spring lead system in May and June, and in lagoons along the Alaska Peninsula as well as openings in the retreating pack ice during spring migration in May and June. Eiders occupying these areas could experience high impacts from oil spills, while those occupying offshore leads and river mouths in the Beaufort Sea and leads in the Bering Sea pack ice in spring, coastal areas of the Y-K Delta in spring and fall, Beaufort Sea lagoons from July to September, and in wintering areas where these species concentrate (e.g., eastern Aleutians, southeastern Bering Sea, St. Lawrence Island polynya) could experience moderate impacts. Approximately 31 oil spills are estimated (see TAble IV.B.4-2) with the addition of the current and future 5-year programs within the range where these species are seasonally abundant (Beaufort Sea to southern Bering Sea).

During spring and fall migration periods (April-May, August-September), Steller's eiders could experience high impacts if an oil spill were to enter Nelson or Izembek Lagoon on the Alaska Peninsula. With the addition of the current and future 5-year programs 31 oil spills could occur in areas traversed by this species during spring migration (Alaska Peninsula to arctic coastal plain).

Black, surf and white-winged scoters are most vulnerable when concentrated during post-breeding molt-migration in the nearshore zone of the Y-K Delta in July and August, and in Nelson Lagoon on the Alaska Peninsula in the period following molt. Scoters occupying these areas could experience high impacts from oil spills, while wintering concentrations from the eastern Aleutians to Prince William Sound are more likely to experience moderate impacts from an oil spill. Approximately 33 oil spills are estimated with the addition of the current and future 5-year programs within the range where these species are seasonally abundant (northern Bering Sea to Gulf of Alaska).

Impacts of most factors on diving duck populations other than oil spills from existing Federal leases and lease sales included in the current and future 5-year programs should remain at a low level. An oil spill originating from a presently leased OCS area could result in moderate to high impacts by contacting substantial proportions of populations of one or more species in this diverse group that are seasonally vulnerable in Beaufort Sea lagoons, Chukchi Sea lagoons and spring lead system, the St. Lawrence Island polynya, the Y-K Delta, and lagoons on the north side of the Alaska Peninsula. Elsewhere, potential impacts are likely to be low although a very large oil spill in the Gulf of Alaska originating from a tanker transporting oil from the TAPS terminus probably has the potential for producing moderate to high impacts in this area.

The current and future 5-year programs suggest that oil and gas development and production could increase in the future, and while overall impacts may not be elevated above moderate or high as discussed above, their certainty of occurrence is likely to increase. The current and future 5-year programs increase oil spill risk in the Gulf of Alaska beyond that presently existing as a result of tankers transporting oil from the TAPS terminus. Multiple oil spills, more probable under assumptions of the current and future 5-year programs, could elevate potential impacts if occurring within a period of one or two generations. Given the oil spill estimates previously discussed, it is reasonable to assume that a major oil spill will occur, enter some of the coastal areas, leads, or lagoons where diving ducks are concentrated, and contact some of the local diving duck population while they are on the water. These oiled diving ducks are likely to suffer a high mortality rate from drowning or hypothermia, some ducks will become sick and later die from ingesting oil, and some with lightly oiled feathers would probably survive. It is highly unlikely that multiple oil spills would contact all of the diving duck habitat along the Alaska and Pacific coastal regions simultaneously, and a lesser possibility of occurring during a critical migration period, entering a coastal area, and contacting ducks on the water. Therefore, the current and future 5-year programs are not expected to substantially increase the existing moderate cumulative impact on diving ducks.

Disturbance impacts are not expected to increase the cumulative impact above that for oil spills alone.

CONCLUSION: The cumulative impacts on diving ducks are expected to be moderate.

(3) Waterfowl

The status of most marine waterfowl in the Alaska and Pacific Regions are not known. Since these birds can show marked short- and long-term fluctuations (Drury, 1979), it is difficult to detect changes in population distributions and densities with precision from most current data. However, as none of the marine waterfowl species in the Alaska and Pacific Regions are being considered for listing as threatened, endangered, or candidate species, their populations are assumed to be stable. The following discussion focuses on the impacts to Arctic (Pacific) loons and western grebes which are used as representatives of marine waterfowl in the Alaska and Pacific Regions.

Compared to the mortality suffered by seabirds in gill and trammel nets (see discussion in Section IV.D.3.b.(4)), loons and grebes have experienced few impacts. In surveys, conducted by California Department of Fish and Game (CDFG) on incidental take of seabirds in gill nets, only 24 loons and grebes were taken during the period between 1983-86 (Collins et al., 1984, 1985, 1986; Volkovich et al., 1987; and CDFG, 1987).

Municipal discharges of organic pollutants into the ocean have had dramatic impacts on resident seabirds (see Section IV.D.3.a.(4) on impacts to brown pelicans). Certainly, loons and grebes pick up organic contaminants while wintering offshore in the Pacific Region (especially in the Southern California Bight); however, to date these contaminants have not been implicated in reproductive impairment on this or any other migratory waterfowl.

The tendency of loons and grebes to aggregate in large numbers in nearshore waters (between 2-5 km (1-3 mi) of shore) makes them particularly vulnerable to nearshore oil spills. In all major oil spills offshore the Alaska and Pacific Regions loons and grebes made up a significant percentage of birds killed (see citations on seabirds, Section IV.D.3.b.(4)). Currently, the greatest risk of an oil spill impacting migrating or wintering marine waterfowl is in the Southern California Planning Area of the Pacific Region and the Gulf of Alaska in the Alaska Region. (As loons and grebes spend the breeding season on and near freshwater lakes in Alaska and Canada, they are largely unaffected by existing OCS activities in the Alaska Region.)

Most marine waterfowl that breed in Alaska and Canada either winter in the Gulf of Alaska or stage there prior to migrating further south. From existing oil and gas activities, birds in the Gulf of Alaska are exposed to the possibility of an oil spill. Also, birds that migrate further south could encounter another oil spill in the Pacific Region. However, an oil spill would have to contact and oil a large number of birds in both areas in the same year to have an impact level greater than the existing low impact from other sources. Indications from previous oil spills show that mortality as a result of an oil spill does not cause population declines which result in changes in distribution or abundance.

Spills occurring in both areas within 2-3 years (one generation) would increase impacts to a higher level. In summary, the impact factor which would most affect migratory marine waterfowl in the Alaska and Pacific Regions is contact with an oil spill. However, even though they have, in some instances, experienced significant losses from nearshore oil spills, their populations appear to be stable. It is estimated that marine waterfowl will experience low impacts from existing projects or proposals but maintain viable populations.

The increment of impacts contributed by normal operations resulting from the current and future 5-year programs are not expected to increase existing impact levels significantly. Potential impacts from normal activities, combined with existing marine vessel traffic, industrial discharges and commercial fishing on marine and coastal birds would probably increase; but impacts are expected not to last more than 1-3 years.

With the addition of the oil and gas activities associated with the current and future 5-year programs, there is an increase in risk that an oil spill could occur and contact migrating or wintering birds in the Pacific Region and the Gulf of Alaska. Birds in the Gulf of Alaska are exposed to a slightly higher risk of an oil spill under the current and future 5-year programs (Table IV.B.4-2). Also, birds that migrate further south could encounter another oil spill in the Pacific Region. With a total estimated mean number of 12 oil spills for the Southern California Planning Area, this is the most likely place birds would be impacted. Given the oil spill estimates previously discussed, it is reasonable to assume that a major oil spill will occur in the southern California coastal area and contact some of the local marine waterfowl species. These oiled marine waterfowl are likely to suffer a high mortality rate from drowning or hypothermia, some of the birds will become sick and later die from ingesting oil, and some with lightly oiled feathers would probably survive. It is highly unlikely that multiple oil spills would contact all of the marine waterfowl habitat along the Gulf of Alaska and southern California coastal regions simultaneously, and a lesser possibility of occurring during a critical migration period, entering a coastal area, and contacting marine waterfowl on the water. An oil spill would have to contact a large number of birds in both areas in the same year to have an impact greater than low. Additional oil spills occurring in both areas within 2-3 years (one generation) could increase impacts to a higher level.

Most species are expected to maintain viable populations throughout the 40-year period. However, the potential for one or more major oil spills contacting birds along the Alaskan and/or California coast during migration has the potential to be locally high. The current and future 5-year programs are not expected to substantially increase the existing low cumulative impact on marine waterfowl.

CONCLUSION: The overall cumulative impacts are expected to be low.

(4) Seabirds

The actual status of many seabirds in the Alaska and Pacific Regions is not known. Since these birds can show marked short- and long-term fluctuations (Drury, 1979), it is difficult to detect changes in population distributions and densities with precision from most current data.

Only the marbled murrelet (outside of Alaska) and the elegant tern are believed to be declining in population (DOI, FWS, 1989). All other seabirds are assumed to have stable populations.

Loons and grebes are the most common nearshore marine bird on the Pacific Coast from October to May. Being nearshore species, they have become habituated to man's activities in the coastal zone. Based on their numbers and distribution in nearshore areas of high vessel traffic in the Alaska and Pacific Regions, it is estimated that vessel traffic has a negligible impact on these species.

The activity that has had the most recent negative impact on the seabird populations in the Alaska and Pacific Regions is gill and trammel net fishing. The following discussion on the impacts of gill netting in the Pacific Region is based largely on Collins et al., 1984, 1985, 1986; Volkovich et al., 1987; and CDFG, 1987. In the Pacific Region, essentially all of the seabird mortality from this fishery took place offshore northern and central California. CDFG estimated that during 1980 to 1982 more than 20,000 seabirds were drowned in nets in Monterey Bay alone. CDFG estimated that some 50,000 seabirds (93% being murres) were drowned during 1983-1986 off northern and central California. This heavy mortality in central California is believed to be the major reason for the over 50% decline in common murre numbers from the late 1970's to 1986 (Takekawa 1988, pers. commun.).

In the Southern California Planning Area there only exist a small gill net fisheries. Annual surveys by CDFG of the Southern California Bight indicate that gill and trammel nets have a negligible impact on seabird numbers, as there has only been 11-17 observed takes/year in the past 3 years .

This excessive mortality in northern and central California prompted the State to restrict gill and trammel net fishing for the protection of non-target marine wildlife offshore northern and central California. Even if this legislation eliminates seabird mortality in northern and central California, it will take several years for populations (especially murres) to recover.

This incidental take in California is small compared to that which occurs in the Alaska OCS Region. In the northern North Pacific Ocean and Bearing Sea, it has been estimated that some 250,000 to 500,000 seabirds are killed annually by the Asian (mostly Japanese and Korean) gill net fisheries for salmon (King et al., 1979; Ainley et al., 1981). The majority of the birds taken are murres, shearwaters, and puffins. As King et al. (1979) noted, although the total standing seabird stock in Alaskan waters may be as high as 100 million birds, the few selectively caught species may be experiencing significant local impacts.

Major offshore oil spills pose a significant threat to seabirds. By far the highest rate of oil spills is from oil tankers, as opposed to platforms or pipelines (DOI, MMS, 1989a). Of the seven well-documented oil spills in the Alaska and Pacific Regions which have killed large numbers of seabirds, six involved tankers from non-OCS sources. Almost all the oil spills occurred in the winter. In 1937, an oil spill from a grounded tanker killed a large number of alcids (primarily common murres), loons, grebes, waterfowl, shorebirds, and gulls (Aldrich, 1938; Moffitt and Orr, 1938). In 1971, two tankers collided at the entrance to San Francisco Bay; the 840,000 barrels of spilled oil killed an estimated 20,000 seabirds composed primarily of grebes, scooters and common murres (Smail et al., 1972). In 1984, the tanker Puerto Rican broke in half south of Southeast Farallon Island; the resulting 35,000 barrels of spilled oil killed an estimated 5,000 birds, of which nearly 90% were common murres (representing a loss of 5% of the breeding population of this species in the Gulf of Farallons) (PRBO, 1985). In 1985 a barge, the Apex Houston, spilled 616 barrels of oil killing about 10,500 seabirds, again targeting common murres (71%) and rhinoceros auklets (15%) (Page and Carter, 1986). In early December 1984 an unknown amount of oil from the sunken hull of the Puerto Rican came ashore in Marin County, oiling approximately 80% of the sanderling population near Bodega Bay. In late December of 1988 the barge Nastucca collided with its tugboat just offshore Grays Harbor in Washington and spilled some 5,500 barrels of bunker crude. Over 9,000 seabirds (most scooters and grebes) were killed from this event. (It is evident from some of these case histories that the size of the oil spill may be less important than the actual location of the oil spill and season of the year.) The impacts of the 10 million gallons spilled from the supertanker, *Exxon Valdez*, in Prince William Sound, AK in March of 1989 are still being assessed.

It is obvious that some of these large oil spills caused excessive seabird mortalities and resulted in locally high impacts. On a Regional (i.e., Pacific Region) or Inter-Regional (Alaska and Pacific Regions) basis, however, impacts of individual oil spills are less severe. From a Inter-Regional population point-of-view, seabirds have numbers in the hundreds of millions. They are adapted to survive in an environment with an unpredictable food supply and a harsh environment and as such are known to have major fluctuations in numbers year-to-year. Natural, annual, adult mortality is on the order of 10-15 percent (Lack, 1954:92; Henny 1972:44; Anderson and Gress, 1983:83). Even losses of thousands of birds in a single event, when considered alone and spaced over 2-3 years, probably has only a low impact on a seabird population as a whole (i.e., they could recover in 1-3 years).

The impacts that certain municipal wastewater discharges and onshore effluents can have on seabirds was illustrated by the dramatic decline of California brown pelicans and cormorants due to discharges of pesticides into the coastal waters of southern California during the mid-1960's (see citation in Section IV.D.3.(4) for the California brown pelican).

Although, there are a host of known contaminants in ocean sediments from discharges offshore - especially in southern California (Thompson, Hershelman, and Gossett, 1988; McCain et al., 1988), to date chlorinated hydrocarbons (DDT and its metabolites) and polychlorinated biphenals (PCBs) appear to cause more reproductive declines and failures in marine and coastal birds than any of the other contaminants (see citation in Section IV.D.3.(4) for the California brown pelican; Gress et al., 1973; and Faber et al., 1972). Following the ban on the dumping of these contaminants in the mid-1970's, some

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seabirds (brown pelicans in particular) began to experience a gradual comeback (Anderson et al., 1975). However, since the half-life of these contaminants are measured in decades, their impacts may be evident for years. (Heavy metals, unlike PCBs or DDT, have not been implicated in reproductive impairment of birds probably because none, except mercury in the organic form of methylmercury, bioaccumulate in the food chain).

In summary, these seabirds experience several potentially severe impacting agents. Combined with other natural environmental disturbances (e.g., storms, El Nino conditions which result in food shortages, introduced predators on breeding colonies), these cumulative impacts can be significant. These agents, singularly or in combination, are the reason certain species have experienced declines.

The incremental of impacts contributed by normal operations resulting from the current and future 5-year programs are not expected to increase existing levels substantially. Potential impacts from normal activities, combined with existing marine vessel traffic, industrial discharges and commercial fishing on marine birds would probably increase but remain low.

However, with the addition of the oil and gas activities associated with the current and future 5-year programs, there is an increase in risk that an oil spill could occur and contact migrating seabirds in Alaska and Pacific Regions. In the Alaska Region this project introduces the risk of an oil spill in planning areas where no risk previously existed. In the Pacific Region it generally only increases the risk of an oil spill occurring. The planning areas with the highest estimated mean number of oil spills are the Navarin Basin, the Gulf of Alaska, the Chukchi Sea, and the Southern California Planning Areas.

A large oil spill in the Navarin Basin is most likely to impact seabirds in adjacent planning areas - specifically St. Matthew Island (in the St. Matthew Planning Area) and the Pribilof Islands (in St. George Basin Planning Area). These islands have probably the largest number of breeding seabirds (mostly murres and auklets) in the North Pacific Ocean. Since an oil spill in winter would most likely be incorporated into the ice to be released in the spring, a large oil spill at almost anytime of the year could impact thousands of breeding seabirds. Most breeding birds migrate south with the onset of ice formation, during migration they could be exposed to a large oil spill in the Gulf of Alaska (see Table IV.B.4-2) as they migrate to the Pacific northwest.

In southern California, the potential for a large oil spill impacting seabirds is also significant. Regardless of the time of year, a large oil spill could impact thousands of breeding or migrating birds. A large oil spill contacting colonies on the Channel Islands (especially San Miguel) could have impacts that are of regional significance and take several years to recover. Oil spills offshore could potentially impact large numbers of migrants as they loaf over the continental shelf or on feeding areas. Of the 12 estimated mean number of oil spills over the 35 year period from all sources, it is reasonable to assume that at least one oil spill will impact a large number of birds on either their colony or major feeding area. It is not expected, however, that multiple oil spills will contact this resource again within 4-6 years.

In summary, locally high impacts are estimated from a single large oil spill in any one of these planning areas within the Alaska or Pacific Region. An oil spill in the Chukchi or Bering Sea and a large oil spill in the Gulf of Alaska during fall or early spring (when large numbers of migrants are present) could have regionally high impacts on murres and auklets. A large oil spill that contacts seabirds in the summer or fall in northern and central California and the spring in southern California could also have locally high impacts. The impact of oil spills on seabirds in the Alaska and Pacific Regions over the next 35 to 40 years is expected to be moderate. The current and future 5-year programs are not expected to increase the existing moderate cumulative impact on seabirds.

Overall, these birds could be affected by several potentially sever impacting agents. Combined with other natural environmental disturbances (e.g., storms, El Nino conditions which result in food shortages, introduced predators to breeding colonies), the cumulative impacts, due to number of birds killed can be significant. These agents, singularly or in combination, are the reason certain species have experienced declines. However, over the next 35- to 40-year period, it is expected that mortality from these factors would require 3 to 5 years to recover and therefore, it is expected that seabirds will maintain viable populations and experience only moderate impacts.

However, when heavy mortality already experienced from gillnetting on portions of the seabird breeding range is combined with continued coastal development and the potential for a major oil spill contacting important island colonies and coastal and offshore feeding areas, the actual impact to one or more species has the potential to be locally high.

CONCLUSION: The cumulative impacts to seabirds from OCS and non-OCS activities are expected to be moderate.

(5) Shorebirds

Like seabirds, shorebirds show dramatic short- and long-term fluctuations in numbers. Therefore, estimates of population size, even when taken over long periods, can be misleading as to the true status of the species. However, since only the snowy plover (*Charadrius alxandrinus nivosus*) and long-billed curlew (*Numenius americanus*) are candidates for listing as threatened or endangered (DOI, FWS, 1989) - all other species of shorebirds are assumed to have at least stable populations. (The eskimo curlew (*N. borealis*) is listed as endangered but is believed to be extinct; the last confirmed sighting was in 1972.)

In the past shorebirds have experienced heavy hunting pressure. During the late 1800's and early 1900's shorebirds were legally hunted by market hunters for their plumage throughout North America. Birds were killed by the thousands as they concentrated on staging areas during their migration. Some populations are estimated to have been reduced by 50 to 95 percent. This excessive overhunting is believed to be the cause of the virtual extinction of the once common Eskimo curlew (Banks, 1977). Since market hunting became illegal in 1900 through 1920 (through a series of Federal and State laws), most shorebirds have recovered; but it is impossible to determine to what extent (Harrington, 1986).

Currently, adverse impacts to most shorebirds come primarily from the loss of winter habitat due to coastal development. (However, the decline in numbers of long-billed curlews and snowy plovers is mainly due to destruction of breeding habitat.)

As mentioned in section III.A.3.b.(5), shorebirds concentrate in large numbers on staging areas during their migration. While on the staging area, birds feed intensively to store up fat which is used to "fuel" their subsequent non-stop flight to the next staging area, which in some cases can be thousands of miles apart separated by unsuitable habitat (Odum et al., 1961; Senner, 1979). For this reason, it is believed that these staging areas are critical to shorebirds an<that their loss could result in reduced population numbers through starvation on wintering grounds and/or reduced productivity on breeding grounds (Goss-Custard, 1977, 1979; Senner, 1979). Loss of coastal wetland habitat to commercial and residential development is nowhere more evident in the Alaska and Pacific Regions, than in California. Speth (1979) reported that the state of California has lost some 261,000 acres (almost 70%) of its coastal wetlands since the early 1900's to a variety of coastal development projects. With human population growth expected to remain constant or increase (especially on the Southern California coast) at best there could be no further net loss of habitat for migrating shorebirds over the life of the project. In this case shorebirds would maintain viable populations and impacts experienced would be low.

A major oil spill that comes in contact with a coastal wetland or estuary has the potential to impact thousands of shorebirds. Further, since most shorebirds tend to feed above the water-line (as opposed to wading and swimming), they generally would not come in direct contact with oil spilled, though their food source could be greatly affected. Therefore, relative to seabirds, shorebirds are less vulnerable to oil spills. Nevertheless, in those instances where shorebird habitat has been contacted by oil, shorebird kills have been significant (Harrison, 1967; Page and Carter, 1986).

Shorebirds are most sensitive to the impacts of spilled oil on their breeding areas and wintering areas because they remain there throughout the season (as opposed to being on the staging areas for only a few weeks). Birds wintering in southern California are exposed to the greatest risk of an oil spill from existing sources. Since shorebird habitat is located throughout the Southern California Planning Area along the coast and since birds are present throughout much of the winter and fall (either wintering or staging), it is reasonable to assume that at least one oil spill will occur and contact shorebird habitat when birds are present. Another oil spill would have to occur and contact birds on the same wintering grounds within 3-5 years or on one of the staging areas in the same year (when birds are present) to have an impact greater than low. However, assuming uniform distribution of the oil spills over the next 35 to 40 years, it is unlikely that another oil spill would occur and contact the same wintering ground or staging area.

In summary, the major existing impact producing agents affecting shorebirds is the destruction of coastal habitat. While shorebirds are vulnerable to the impacts of spilled oil, relative to seabirds, they have

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experienced fewer impacts from most oil spills (Bourne, 1968: Table 2). From existing projects and proposals, it is expected that shorebirds will maintain viable populations and experience low impacts.

The increment of impacts contributed by oil and gas activities associated with the current and future 5-year programs are not expected to increase existing levels substantially, because there are no lethal impacts associated with drilling discharges, increased noise levels, or disturbance from vessel traffic which could result in impacts requiring greater than one year recovery time. Potential impacts from normal activities, combined with existing marine vessel traffic and industrial discharges, on coastal birds would probably increase but remain sublethal impacts.

A major consequence of the current and future 5-year programs on shorebirds is the increased risk of an oil spill occurring and contacting habitat in the Alaska and Pacific Regions. In the Alaska Region this project introduces the risk of an oil spill in planning areas where no risk previously existed. In the Pacific Region it generally only increases the risk of an oil spill occurring. The planning areas with the highest estimated mean number of oil spills are the Navarin Basin, the Gulf of Alaska, the Chukchi Sea, and the Southern California Planning Areas.

A large oil spill in the Navarin Basin is most likely to impact shorebirds in the Y-K Delta (in the St. Matthew Planning Area). This area is the most productive waterfowl and shorebird breeding area in North America. Since an oil spill in winter would most likely be incorporated into the ice to be released in the spring, a large oil spill at almost anytime of the year could impact thousands of breeding shorebirds. As most breeding birds migrate south with the onset of ice formation, they could also be exposed to a large oil spill in the Gulf of Alaska (see Table IV.B.4-2) as they stage in the Prince William Sound Area (mostly in the Cooper River Delta) prior to migrating further south. Essentially the same is true of coastal birds in the Chukchi Sea. Additionally, shorebirds like dunlins and sandpipers that migrate as far south as the Southern California Planning Area (see Table IV.B.4-2) could be exposed to an additional risk.

Based on the length of time birds spend in the following areas and the importance of the areas in their life cycle, it is assumed that an oil spill will occur and contact two of the three following sensitive shorebird areas within 1-3 years when shorebirds are present: 1) the Y-K Delta from an oil spill originating in the Navarin Basin Planning Area; 2) the Cooper River Delta from an oil spill originating in the Gulf of Alaska; and 3) a coastal wetland the southern California (e.g. Morro Bay, Mugu Lagoon, or Goleta Slough). Based on the oil spill assumption for this analysis, locally high impacts would be estimated from a single large oil spill that contacts shorebird habitat in any one of the planning areas in the Alaska and Pacific Region. The current and future 5-year programs are not expected to increase the existing low cumulative impact on shorebirds.

CONCLUSION: The cumulative impacts of OCS and non-OCS activities are expected to be low to shorebirds.

3. Fish Resources

a. Pacific Salmon

(1) Alaska Region

Alaska Pacific salmon resources range through all of the planning areas off Alaska but are not as numerous in the Beaufort, Chukchi, Hope, and Navarin Basins. Because of repeating adverse environmental conditions and lack of long-term management, Alaskan salmon populations were historically over-exploited and sometimes reduced to dangerously low levels. Current management administration has largely removed the majority of problems; thus the populations may now be at optimum management levels, that are consistent with available habitat at sea and in freshwater spawning/rearing areas. Although Alaskan salmon populations are generally at high levels, there are areas where the numbers are below optimum levels. These areas are localized and short-term, and the reductions are usually for a single species; for example, the Chignik sockeye salmon run on the south Alaska Peninsula was reduced from former high levels in 1988, as was the Kodiak Island pink salmon run).

Commercial fishing for salmon, a major industry in Alaskan waters, has significant impacts on salmon population levels. While salmon stocks were once overfished, improved fisheries management now limits over-exploitation; and these species are now managed to provide maximum sustained yield. The illegal and incidental catch of salmon by foreign fleets in the eastern Bering Sea may also have a significant impact on salmon numbers. However, there is no information available as to the current total catch, and impacts are difficult to quantify.

Logging, placer mining, dredging and filling, and pollutant discharge in waters where salmon migrate, spawn, and grow prior to their seaward migration may also have some adverse impacts on salmon populations. Increased siltation from erosion caused by careless logging, placer mining, or construction activities could result in a reduction in egg and fry survival and/or a reduction in available spawning habitat, leading to a decline in overall productivity for affected streams. In Alaska, these types of activities are localized and tend to affect only small segments of the Statewide salmon habitat. Presently, there are no means to accurately quantify these impacts, given the limited scope of these operations and their comparatively limited number. The overall cumulative impact of these activities on the salmon populations, Statewide, are estimated to be very low. However, they can have severe impacts in the limited area where the activity occurs.

Other activities that could have some effect on salmon populations would be exploratory drilling on tracts leased in prior lease sales. Currently, there are no immediate plans for companies to drill on leases within the major distribution range of Pacific salmon populations. There are, however, a number of active leases on which oil companies could drill. If drilling does occur, salmon would be most greatly at risk from large accidental oil spills. However, of the more than 8,000 exploratory wells that have been drilled on the OCS, no large accidental oil spills have occurred. If a discovery is made, the risk to salmon would increase during development and production activities.

To affect salmon, an oil spill would need to contact the fish and/or their food supply. Salmon, both immature smolts and spawning adults, usually occur in marine waters at depths of 1-5 fathoms (6-30 ft), and their schools do not constitute closely-concentrated bands, but rather separate groups that are constantly changing density and configurations in response to various conditions. Many researchers have studied the direct effects of petroleum hydrocarbons on Pacific salmon and have reported lethal and sublethal responses (Rice, 1979; Malins et al., 1981; Moles et al., 1979; Brocksen and Baily, 1973; and Weber et al., 1981).

Salmon are migratory with limited time in a given area; hence, the probability of being contacted by an oil spill for an extended period of time is very low. Even a large oil spill, either offshore or coastal, would contact only a small portion of the pelagic salmon habitat. Salmon also seem to be able to detect some hydrocarbons in the water and to divert from these areas. However, if the spill occurs along the spawning migration route or at the mouth of spawning streams, diversion from an oil spill could affect the spawning success of that population. Although salmon are concentrated in the upper portion of the water column, where they are likely to come in contact with a slick or the water-soluble fraction around and beneath it, hydrocarbon concentrations in open-water areas are generally well below 1 ppm. Researchers have reported that adult salmon experience mortality following exposure to concentrations in excess of 3 ppm. Consequently, mortalities would be limited in number, although any sublethal effects would be difficult to quantify. Therefore, because of the limited amount of habitat which may be affected, the typical concentration of water-soluble hydrocarbons, and the potential risk of an accidental oil spill, it is estimated that overall impacts from an accidental oil spill would be very low.

Oil and gas activities associated with the addition of the current and future 5-year programs that might have impacts on salmon are: (1) oil spills, (2) drilling discharges, (3) pipeline installation, and (4) onshore construction associated with offshore exploration and development. These additional activities might cumulatively affect salmon on the high seas and on their spawning and rearing areas over a 40-year period. During the course of offshore exploration and development off Alaska, more than 600 exploration wells and 52 production platforms are projected to be established (Table IV.B.1-1). Based upon historic spill rates, it is estimated that about 42 oil spills of 1,000 barrels or greater might occur (see Table IV.B.4.-2). The oil spills are assumed to be equally distributed over the entire 40-year period of these projects and over the entire Alaska OCS. Because of the long time period over which the spills may occur and the extensive ocean area involved, the probability of contacting a significant portion of salmon, their habitat, or food supply is very low. Even given multiple oil spills within the same year, only a small portion of the Statewide salmon populations would be contacted. Impacts of oil spills on salmon have been previously described and have been shown to be very low.

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Drilling discharges also have components that would prove toxic to salmon, with the number of wells drilled releasing large weights and volumes of these materials into ocean waters and to the benthos. While sublethal to lethal impacts of these materials have also been substantiated by studies, the benthic area affected by them is not within the depths at which salmon normally migrate; the area contacted by the discharges is comparatively small, usually measured in hundreds of square meters.

Pipeline installation requires some excavation/disturbance of the ocean bottom with resultant turbidity. This is a temporary impact that dissipates very rapidly, and the turbidity should not extend to the pelagic waters where salmon migrate and rear. Onshore construction of pipelines, petroleum holding/processing facilities, and support installations could affect salmon spawning/rearing streams; however, development planning can prevent these impacts through siting away from salmon streams.

Conclusion: Overall, the cumulative impact of OCS and non-OCS activities on salmon is very low.

(2) Pacific Region

According to the PFMC (1982, 1984), in the early 1980's, the long-term trend for many salmon stocks in the Pacific Region was towards lower levels of abundance. In 1981, for example, most stocks of chinook and coho salmon in the Pacific Region were considered to be in a depressed condition, and were exhibiting a declining trend in abundance. More recent information (PFMC, 1989) on the statuses of major chinook, coho, and pink salmon stocks from the rivers within the Pacific Region indicates that at least some populations or runs have increased in abundance over the past several years as a result, in part, of stringent management efforts by the PFMC.

Long-term cumulative impacts may occur to migratory salmon stocks originating in rivers of the Pacific Region as a result of existing and future nonoil-related factors or activities. The principal nonoil-related factors or activities that may impact migratory salmon stocks over the next 35 years include natural fluctuations in environmental conditions (e.g., freshwater runoff and stream flows, ocean temperatures, and food supply, etc.) which affect the survival of all life-history stages. These impacts include mortality of juvenile and adult salmon resulting from commercial and sport fishing activities, and the loss and/or degradation of freshwater spawning and nursery habitat. Juvenile salmon production can also be affected by various onshore activities such as hydroelectric power projects, water diversions for agriculture and development, and various timber and construction activities.

Commercial, sport, and tribal Indian fishing for Pacific salmon produced from rivers in the Pacific Region are expected to continue over the next 35 years in marine waters offshore the States of California, Oregon, and Washington; offshore British Columbia; possibly offshore southeast Alaska and in the Gulf of Alaska; and to a lesser extent in the freshwater rivers producing the stocks. Although the relative contributions to total fishing mortality from these various sources of fishing pressure are not clear, the most intense fishing pressure on salmon stocks is expected to occur in the Exclusive Economic Zone (EEZ) that is regulated by the PFMC offshore California, Oregon, and Washington. Historical PFMC landings data for salmon taken in the EEZ of the Pacific Region indicate that the annual commercial and sport catch (i.e., fishing mortality) of chinook, coho, and pink salmon can vary substantially (PFMC, 1989). The magnitude of future salmon harvests by commercial and sport fisheries in the Pacific Region is expected to be highly variable, but generally falls within the range observed since the PFMC began regulating ocean salmon fisheries in the late 1970's.

The impact of existing and future commercial, sport, and other types of fishing pressure on salmon populations is difficult to estimate. In large part, the impact of fishing pressure on the abundance of salmon stocks will be based on the accuracy of PFMC pre-season salmon abundance estimates, and the effectiveness of PFMC management measures that are designed to control fishing pressure and harvest levels so that spawning escapement goals can be achieved and stock sizes maintained or increased. Although a major goal of PFMC management efforts is to avoid overfishing and achieve spawning escapement goals, it is very likely that some degree of overfishing will occur several times over the next 35 years because of the difficulty in accurately assessing the abundance of spawning runs and then allocating the available fish among competing fisheries and escapement. Reductions in the abundance of specific salmon stocks are expected to result from this overfishing, but the impacts are expected to generally last from 1-5 years at most because of ongoing PFMC management efforts.

Significant reductions have occurred historically in the spawning and rearing habitats available to salmon populations originating from rivers throughout the Pacific Region. As a result of these habitat losses, significant long-term reductions in salmon populations have occurred throughout the Region over the last

20-50 years. Although efforts to rehabilitate freshwater habitat are expected to occur in some areas, it is unlikely that significant improvements in either habitat availability or quality will occur in the next 35 years. These activities (e.g., hydroelectric plant operations, water diversions, etc.) that have caused these historical habitat problems are likely to continue in the future.

Because the abundance of salmon runs and populations are, at least in part, related to the productive capacity of spawning and rearing habitats, habitat changes over the next 35 years would be expected to influence the abundance of salmon populations. Based on projections made by the PFMC (1981), habitat availability in this region, with or without rehabilitation efforts, is expected to remain relatively unchanged in the near future (i.e., 10-20 years), except for marginal improvements in rivers supporting some stocks. Although marginal improvement in the availability of habitats for some stocks is expected in the future, the overall productive capacities of freshwater spawning and rearing habitats for salmon are not expected to change significantly over the next 35 years. As a result, long-term changes in the abundance of salmon populations in the Pacific Region are not likely to be attributable to reduced habitat over the next 35 years.

Long-term cumulative impacts may occur to migratory salmon stocks as a result of both existing and approved oil-related activities. The principal agents that could potentially affect migratory salmon stocks over the next 35 years as a result of existing and approved oil/gas activities include seismic survey activities and drilling discharges in southern California, platform and pipeline oil spills from exploration and development activities in southern California, and oil spills from TAPS and foreign import tanker activity throughout the Pacific Region, as well as the Gulf of Alaska.

Seismic survey activities in southern California over the next 35 years as a result of existing oil and gas exploration and development are expected to be relatively limited in number, and consist primarily of site-specific high resolution geohazards surveys and to a lesser extent localized deep penetration surveys. These surveys are expected to occur primarily in the Santa Maria Basin and Santa Barbara Channel over the next 10-15 years as exploration and/or development of existing leases take place.

Based on existing information, such surveys harm few, if any, juvenile or adult fish, including coho salmon smolts exposed to airgun discharges at distances as close as 1 meter from the source (Falk and Lawrence, 1973; Weaver and Weinhold, 1972). Recent field studies (Greenridge Sciences Inc., 1985; Dalen and Knutsen, 1986; Battelle and Bolt Beranek and Newman [BBN], 1987) have been somewhat equivocal but indicate that the localized distribution and abundance of rockfish and other species may be affected somewhat in response to acoustic signal exposure from airgun sources.

Based on available information, such impacts are expected to be very localized and short-term, lasting on the order of several hours to several days at most. The seasonal abundance of migrating Pacific salmon in southern California is relatively low compared to other areas in the Pacific Region; however, salmon can be expected to appear where seismic survey activities will occur over the next 35 years. Migrating salmon are expected to be relatively dispersed while in southern California; thus only a portion of the fish in the area are likely to be affected by acoustic discharges. Based on existing information, acoustic discharges from existing and future seismic survey activity may cause localized and temporary (hours to days) changes in the distribution of salmon migrating through the Santa Maria Basin and Santa Barbara Channel; however, such activities are not expected to cause any discernible lethal impacts that would reduce the abundance of salmon populations.

Drilling discharges (i.e., drill muds and cuttings) are expected to occur in southern California from exploratory, delineation, and production wells over the next 35 years from existing leases within the area. The exploratory, delineation and production wells are expected to be drilled in the Santa Maria Basin and Santa Barbara Channel over the next 10-15 years. Discharges from exploratory and delineation wells are expected to occur over a relatively short period of time (i.e., 1-3 months), whereas discharges from production platforms are expected to occur intermittently over a period of several years as multiple wells are drilled from each production platform.

Approximately 90 percent of the volume of the muds and cuttings discharged from a drilling vessel or platform settle to the seafloor rapidly. The remaining 10 percent, which are typically the smaller particles, form a surface or near surface plume which largely dissipates within 1,000 m of the discharge point. Neff (1985) reviewed substantial literature that indicated drilling muds or fluids are rapidly diluted within several meters of a discharge location, and that these discharges generally result in no short-term or acutely lethal impact to marine organisms. The relative abundance of migrating Pacific salmon in

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southern California is low compared to other areas in the Pacific Region. Salmon, however, can be expected to occur seasonally in this area. The salmon are expected to be relatively dispersed; thus, only a small number of the fish are likely to come into contact with these intermittent and rapidly diluted discharges.

Any exposure to these discharges is expected to occur for only short periods of time. Temporary exposure of migrating salmon to these drilling discharges may result in localized and short-term (minutes to hours) changes in distribution if fish avoid the discharge plume; however, such discharges are not expected to cause any discernible lethal impacts that would result in a decline in the abundance of salmon populations.

A total of 21 oil spills are estimated to occur over the next 35 years as a result of existing oil and gas activities in southern California, tanker activity in the Gulf of Alaska (i.e., TAPS oil production), and tanker activity (i.e., TAPS and foreign imports) offshore Washington, Oregon, central California, and southern California (see Table IV.B.4-2). Only three of these oil spills, however, are estimated to occur in southern California from either platforms or pipelines. The remainder of these oil spills are estimated to occur as a result of tanker activity.

The life-history stages of Pacific salmon that are most sensitive to oil exposure are outmigrating smolts, nearshore feeding juveniles, and adults that are beginning to ascend their home rivers to spawn (Wilson, 1972; Rice et al., 1975; Moles et al., 1979; American Petroleum Institute, 1984; Malins et al., 1978; Nakatani et al., 1985, 1986; and Brannon et al., 1986). These life history stages typically occur in estuaries, or in shallow, nearshore areas that are in relatively close proximity to the home river of the population. In contrast, pelagic juveniles or adults that are migrating in offshore waters are not expected to come into contact with spilled oil in significant numbers, because they normally are widely dispersed offshore.

For these reasons, salmon stocks originating in the Pacific Region are only expected to be affected by oil spills that occur and contact those areas where salmon producing rivers are located (i.e., Washington, Oregon, and northern and central California). Conversely, oil spills that occur in the Gulf of Alaska or southern California are not expected to affect salmon stocks originating in Washington, Oregon, or California because the life-history stages of these stocks that are most sensitive to oil spills typically do not occur in these areas.

A total of three oil spills are estimated to occur offshore Washington and Oregon, with another three occurring offshore central California (see Table IV.B.4-2). These oil spills are estimated to occur from tankers transporting TAPS or imported oil. It is assumed that two of these oil spills will occur within 1 year over the next 35 years; however, in general these oil spills are assumed to be evenly distributed in time and among seasons over the next 35 years. Thus, these estimated tanker oil spills are estimated to occur in different seasons offshore Washington, Oregon, and central California once every 10-12 years, with two oil spills occurring in two different areas (assumed to be Washington and central California) within 1 year over this period. These oil spills are assumed to contact and affect sensitive life stages (i.e., smolts, juveniles, and/or prespawning adults) of salmon occurring in nearshore waters of productive salmon rivers since these life stages are expected to occur throughout the year in many areas.

As discussed previously, these oil spills are expected to affect salmon populations by causing direct mortality of outmigrating smolts, reducing the survivorship of outmigrating smolts, or by reducing the spawning escapement of adult salmon through "straying" or delays in spawning runs. This reduction in smolt production or spawning escapement could result in a future decline in the abundance of returning spawners. The magnitude of this decline is expected to be highly variable, but is expected to be related to the degree of oil contamination that occurs, the duration of the contamination, the coastal area and number of productive river systems affected, and the proportion of total smolt production and/or the spawning adult population that is affected.

The impacts to salmon from individual oil spills are generally expected to be localized unless a large number of productive rivers and streams, or a major river system (e.g.,Columbia River) is affected. In this hypothetical case where two oil spills occur in a single year (e.g., Washington and central California) and sensitive life-history stages are affected, the overall impacts to salmon are expected to be greater since a larger area and more salmon populations will likely be affected. Since salmon produced in any 1 year generally spend from 1-5 years (depending upon the species and/or stock) maturing before returning to spawn, their contribution to future spawning runs will also be largely spread over a 1- to 5-year period.

For this reason, the decline in abundance of future spawning runs or populations resulting from the impacts of one or even two oil spills in different areas is expected to be spread primarily over a period of 1-5 years following the oil spill event.

Both the magnitude and duration of impacts to salmon populations from oil spills, however, are likely to be somewhat buffered, since individual spawning runs or populations in any given year are generally comprised of fish produced over several preceding years (i.e, several year classes), and not just the year class affected by a prior oil spill. Since individual oil spills in Washington, Oregon, and central California from tanker activity are estimated to occur at intervals of 10-12 years over the next 35 years, and the duration of impacts from individual oil spills is estimated to be 1-5 years, the impacts of multiple, widely-spaced oil spills on salmon populations from this Region are not expected to be overlapping or cumulative.

The principal nonoil-related factors or activities that may reduce migratory salmon stocks with the addition of the current and future 5-year programs over the next 35 years are the same as those discussed above. In addition, other factors influencing salmon stocks include natural fluctuations in environmental conditions (e.g., freshwater runoff and stream flows, ocean temperatures, and food supply) which affect the survival of all life-history stages. These impacts include mortality of juvenile and adult salmon resulting from commercial and sport fishing activities, and the loss and/or degradation of freshwater spawning and nursery habitat. Salmon production can also be affected from various onshore activities such as hydroelectric power projects, water diversions for agriculture, and various timber and construction activities.The impacts of these factors and/or activities on migratory salmon stocks originating in the Pacific Region with the addition of the current and future 5-year programs are expected to be the same as those discussed above for existing activities.

Long-term cumulative impacts may occur to migratory salmon stocks as a result of existing, approved, and future OCS activities, as well as existing and future non-OCS oil-related activities. The principal activities which could potentially affect migratory salmon stocks include seismic survey activities and drilling discharges from oil- and gas-related activities, oil spills resulting from development activities (platforms and pipelines), and oil spills from related tanker (i.e., TAPS and foreign imports) activity throughout the Pacific Region and the Gulf of Alaska.

Seismic survey activities in the Pacific Region and the Gulf of Alaska are expected to consist primarily of prelease deep penetration surveys covering large areas, and postlease site-specific high resolution geohazard surveys (for exploration, development, and pipelines) over the next 35 years with the addition of the current and future 5-year programs. Prelease surveys are expected to occur throughout the Pacific Region and Gulf of Alaska, generally preceding lease sales, whereas the majority of high resolution surveys are expected to occur in southern California as a result of exploration and development.

Migrating juvenile or adult Pacific salmon originating from rivers located primarily in Washington, Oregon, and northern and central California are expected to occur in offshore areas in the vicinity of seismic survey operations throughout the Pacific Region and the Gulf of Alaska over the next 35 years. As discussed for the hypothetical case from existing activities, however, available studies indicate that acoustic signals produced by airguns and other devices used in seismic surveys harm few, if any, fish and result in little more than localized and temporary changes in distribution of localized fish populations. Therefore, oil- and gas-related seismic surveys throughout the Pacific Region and the Gulf of Alaska over the next 35 years may cause localized and temporary (hours to days) changes in the distribution of migrating salmon, but are not expected to cause any discernible lethal impacts that would reduce the abundance of salmon populations.

Drilling discharges (i.e., drill muds and cuttings) are expected to occur in the Gulf of Alaska and throughout the Pacific Region from exploratory, delineation, and production wells drilled over the next 35 years with the addition of the current and future 5-year programs. As with seismic survey activities, the vast majority of these wells are expected to be drilled in southern California. Discharges from individual exploratory and delineation wells are expected to occur over a relatively short period of time (i.e., 1-3 months), whereas discharges from production platforms are expected to occur intermittently over a period of several years as multiple wells are drilled from individual production platforms.

Although migrating salmon are expected to pass through areas where drill muds and cuttings are discharged over the next 35 years, only some of the fish passing through an area with drilling are likely to come into contact with these materials since fish are expected to be relatively dispersed, discharges are expected to occur intermittently, and discharges are expected to be diluted rapidly. Exposure to these discharges, if at all, is also expected to occur for only short periods of time. As discussed above, the available literature indicates that these types of drilling discharges generally result in no short-term or acutely lethal impacts to marine organisms, including fish. Thus, temporary exposure of migrating salmon to these drilling discharges may result in localized and short-term (minutes to hours) changes in distribution if fish avoid the discharge plume; however, such discharges are not expected to cause any discernible lethal impacts that would result in the reduced abundance of salmon populations.

With the addition of the current and future 5-year program, a total of 29 oil spills (see Table IV.B.4-2) are estimated to occur over the next 35 years as a result of oil and gas activities in California, tanker activity in the Gulf of Alaska (i.e., TAPS oil production), and tanker activity (i.e., TAPS and foreign imports) offshore Washington, Oregon, and California. Eleven of these oil spills, (seven in southern California) are estimated to occur from platforms or pipelines as a result of OCS activities. The remainder of these oil spills are estimated to occur as a result of tanker activity (see Table IV.B.4-1). As discussed for existing oil and gas activities, the life-history stages of Pacific salmon that are most sensitive to oil exposure are expected to be outmigrating smolts, nearshore feeding juveniles, and adults that are preparing to ascend their home rivers to spawn. Thus, as for the case analyzed above, salmon stocks originating in the Pacific Region are expected to be affected only by oil spills that occur in those areas where salmon producing rivers are located.

Conversely, oil spills that occur in the Gulf of Alaska and southern California are not expected to reduce salmon stocks originating in Washington, Oregon, or California since the life-history stages of those stocks that are most sensitive to oil spills do not typically occur in these areas. With the addition of the current and future 5-year programs, Pacific Region salmon populations are expected to be affected by eight oil spills occurring offshore Washington, Oregon, northern California, and central California over the next 35 years (see Table IV.B.4-2 for the distribution of oil spills within the planning areas).

Only two oil spills, one each in northern and central California, are estimated to occur from the future and current 5-year program, (i.e., platform spills). The remainder of these oil spills are estimated to occur as a result of TAPS or foreign import tanker activity. It is assumed that two of these oil spills will occur in 1 year over the next 35 years (assumed to be in Washington and central California); however, in general these oil spills are assumed to be distributed evenly over the next 35 years and among seasons. Thus, oil spills are generally estimated to occur in different seasons offshore Washington and/or Oregon once every 12 years, offshore northern California once every 17-18 years, and offshore central California once every 9 years, with two oil spills occurring in two different areas (assumed to be Washington and central California) in 1 year over this 35-year period.

These oil spills are assumed to contact and affect sensitive life stages (i.e., smolts, juveniles, and/or prespawning adults) of salmon occurring in estuaries or in nearshore waters adjacent to productive salmon rivers, and are, therefore, expected to reduce salmon populations by causing direct mortality of outmigrating smolts, by reducing the survivorship of outmigrating smolts, or by reducing the spawning escapement of adult salmon through "straying" or delays in spawning runs. This reduction in smolt production or spawning escapement could result in a future decline in the abundance of returning spawners for the stock or population affected. The magnitude of this decline is likely to be highly variable, but it is expected to be related to the degree of oil contamination that occurs, the duration of the contamination, the coastal area and number of productive river systems affected, and the proportion of total smolt production and/or the spawning adult population that is affected.

The impacts to salmon from individual oil spills are generally expected to be localized unless a large number of productive rivers and streams, or a major river system (e.g., Columbia River) is affected. In the case where two oil spills in different areas occur in a single year (e.g., Washington and central California), and sensitive life-history stages are contacted, the impacts to salmon are expected to be greater since a larger area and more salmon populations are likely to be affected. Since salmon produced in any 1 year spend from 1-5 years (depending upon the species and/or stock) maturing before returning to spawn, their contribution to future spawning runs will also be largely spread over a 1- to 5-year period. For this reason, the decline in abundance of future spawning runs or populations resulting from the impacts of one or two oil spills in any given year is expected to be spread primarily over a period of from 1-5 years following the spill event.

Both the magnitude and duration of impacts to salmon populations from oil spills, however, are likely to be somewhat buffered, since individual spawning runs or populations in any given year are generally

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comprised of fish produced over several preceding years (i.e, several year classes), and not just the year class affected by a prior oil spill. Since individual oil spills in Washington, Oregon, northern California, and central California from oil and gas production and tanker activity are estimated to occur at intervals of 9-17 years over the next 35 years, and the duration of impacts from individual oil spills is estimated to be 1-5 years, the long-term impacts of multiple, widely-spaced oil spills on Pacific Region salmon populations are not expected to be overlapping or cumulative.

CONCLUSION: The long-term cumulative impacts to some migratory salmon populations originating in the Pacific Region are expected to be moderate, as a result of the combined impacts of overharvesting by commercial and sport fishermen and oil spills resulting primarily from tanker activity.

b. Walleye Pollock

The walleye pollock very likely comprises the largest commercially valuable biomass of the deepwater finfishes in North Pacific and eastern Bering Sea waters. While pollock occur in all North Pacific and Bering OCS planning areas, the largest populations are found in the Gulf of Alaska near Kodiak Island and in the Bering Sea along the continental shelf in the St. George, North Aleutian, and Navarin Planning Areas. The fish, while considered to be a deepwater species, exhibit considerable upward changes in depth which appears to be somewhat related to light. The eggs and early larvae are present at surficial to shallow depths.

Pollock are the most abundant demersal fish on the continental shelf of the Bering Sea. Their populations declined in the early 1970's because of overharvesting by foreign fisheries, but slowly increased to a standing stock biomass of approximately 7.5 million tons by 1979 (Thorsteinson, 1984). The Bering Sea stock is currently stable, although smaller than prior to its decline (DOI, MMS, 1985a). In the Gulf of Alaska, a large, dense group of prespawning and spawning pollock was discovered in the Shelikof Strait area in 1980 (DOI, MMS, 1984a). Since that date, they have been fished in the Shelikof Strait, and the total biomass of pollock has declined substantially. The reasons for this decline are not known, but overfishing and poor recruitment are both possibilities. In the past, it was believed that pollock from the entire central and western Gulf of Alaska migrated to the Shelikof Strait in the spring (North Pacific Fisheries Management Council, 1988). If so, then the population of pollock in the Gulf of Alaska could be at a very low level. It is also possible that the premise of extensive concentration in the Shelikof Strait from a much broader area is not valid. From existing activities, walleye pollock would be affected principally by the commercial trawl fisheries that harvest large amounts of these fish annually. Included is a roe fishery that sometimes discards all but this high-value portion of the fish. The State fisheries resources agency attempts to manage this species for a maximum sustainable yield.

Oil or fuel spills from exploratory drilling on active leases from past lease sales or from fishing vessels could have an impact on pollock, directly to their eggs and larvae or indirectly to their food supply. Direct toxic effects could occur particularly during the short time period when the eggs are near the surface. Pollock, however, have an extended spawning season and range of waters; hence, the probability of oil and gas operations contacting vulnerable eggs and pre-larvae to the point where a noticeable population impact could result is very low. Further, a relatively long overall spawning period for this fish, measured over some months, and the relative low density of its eggs, measured in units of tens per cubic meter of seawater versus thousands of eggs per female, would apparently preclude any significant adverse impact on the species.

Discharges from offshore drilling are largely to the benthic zone, and any toxic effect to the biota is usually limited to within a hundred meters from the discharge point. These discharges are also intermittent which further limits their impacts. The conclusion then is that drilling discharges would have very low impact on the bathypelagic walleye pollock, including eggs and larvae.

Impacts with the addition of the current and future 5-year programs could be expected to be qualitatively similar but quantitatively slightly higher than without it. Oil spills from platforms, pipelines, or tankering could be expected to produce the greatest impacts. A mean number of about 30 oil spills of 1,000 barrels or greater could be estimated to occur within the major range of the species over about a 40-year time period (see Table IV.B.4-2).

If walleye pollock eggs and early larvae inhabiting upper pelagic to surface waters were exposed to two oil spills originating from two different planning areas during a single spawning season, the adverse impact to the species would increase. However, given the species broad distribution in comparison with the relatively limited areal extent of all save the largest oil spills, the spill-related population loss above the natural mortality would very likely not be discernible.

CONCLUSION: Cumulative activities would have a very low impact on walleye pollock populations.

c. Steelhead Trout

The abundance of steelhead in California has declined dramatically since the 1950's due to increased sport fishing pressure, and damage to freshwater and estuarine fish habitat as a result of dam construction, water diversion, other types of construction, and generally improper land management practices (Barnhart, 1986). In California, attempts are being made to maintain existing natural stocks of steelhead and their spawning and rearing habitat, to restore or enhance presently degraded habitat, and to supplement natural production with hatchery produced steelhead (CDFG, 1975, as cited in Barnhart, 1986). However, in some rivers steelhead production and a fishery would be nonexistent without hatchery produced stocks.

A similar situation exists in Oregon and Washington where steelhead abundance has declined from excessive sportfishing pressure and habitat loss and/or degradation (Pauley et al., 1986). In particular, the presence of dams and reservoirs, which cause loss of natural habitat and increased mortality of outmigrating smolts, has contributed greatly to the serious reduction of steelhead produced from Columbia River stocks (Pauley et al., 1986). Other factors contributing to the decline of steelhead include poor logging, road building and irrigation practices, and overgrazing by livestock. As in California, natural steelhead runs are heavily supplemented by hatchery stocking in Oregon and Washington.

The principal nonoil-related factors or activities that may impact migratory steelhead stocks over the next 35 years include natural fluctuations in environmental conditions, sport and tribal Indian fishing activities, the loss and/or degradation of freshwater spawning and nursery habitat, and various onshore activities such as hydroelectric power projects, water diversions for agriculture and development, and various timber and construction activities.

Sport and tribal Indian fishing for steelhead produced from rivers in California, Oregon, and Washington are expected to continue over the next 35 years, primarily in the freshwater streams and rivers supporting individual stocks. Additional fishing effort for steelhead is expected to occur in marine waters offshore California, Oregon, and Washington, and possibly offshore southeast Alaska and in the Gulf of Alaska as a result of foreign intercepts. Although the relative contributions to total fishing mortality of steelhead from these various sources of fishing pressure are not clear, the most intense fishing pressure on steelhead stocks is expected to occur in the freshwater streams and rivers supporting steelhead production.

Regulation of this freshwater and nearshore fishing effort on steelhead stocks is expected to continue over the next 35 years under the jurisdiction of the States of California, Oregon, and Washington. Historical catch data for steelhead produced in Washington, and presumably Oregon and California, indicate that the annual sport and tribal Indian catch (i.e., fishing mortality) can vary substantially (Pauley et al., 1986). The magnitude of future steelhead harvests by sport and tribal Indian fisheries in the freshwater streams and rivers of California, Oregon, and Washington is expected to be highly variable from year to year, but is likely to generally fall within the range of harvests observed since the mid- to late-1970's.

The impact of existing and future sport, tribal Indian, and other types of fishing pressure on steelhead populations originating in California, Oregon, and Washington is difficult to estimate, but it is expected to be similar to that discussed for Pacific salmon. In large part, the impact of sport and tribal Indian fishing pressure on the abundance of steelhead stocks will be based on the accuracy of pre-season stock abundance estimates made by the respective anadromous fish resource management agencies in Washington, Oregon, and California, and on the effectiveness of their management measures designed to control fishing pressure and harvest levels so that spawning escapement goals can be achieved and stock sizes maintained or increased. If pre-season abundance estimates are inaccurate and excessive fishing pressure is allowed on one or more stocks, then insufficient spawning escapement may occur that could result in a reduced level of spawning and smolt production. This reduction in smolt production could result in a future decline in the abundance of the returning spawners. The magnitude of this decline is expected to be highly variable, but it is generally expected to be related to the magnitude of overfishing and the associated reduction in escapement, and possibly other unrelated factors. Since steelhead produced in any 1 year generally spend from 2-4 years (depending upon the stock) maturing before returning to spawn, their contribution to future spawning runs will also be largely spread over a 2- to 4-year period.

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For this reason, the decline in abundance of future spawning runs or populations resulting from overfishing and insufficient spawning escapement in any given year is expected to be spread primarily over a period of 2-4 years. However, the actual magnitude and duration of impacts on steelhead abundance from overfishing and reduced spawning escapement are expected to be somewhat buffered, since individual spawning runs or populations in any given year are typically comprised of fish produced over several preceding years (i.e, several year classes), not just the year class impacted by overfishing.

Although a major goal of State agencies responsible for anadromous fish resource management is to avoid overfishing and achieve spawning escapement goals, it is very likely that some degree of overfishing will occur several times over the next 35 years because of the difficulty in accurately assessing the abundance of spawning runs, and then allocating the available fish among competing sport and tribal Indian fisheries and escapement. Reductions in the abundance of specific steelhead stocks are expected to result from overfishing; however, the impacts are expected to generally last 2-4 years at most because of ongoing fishery management efforts by State resource agencies. Significant reductions have occurred historically in the spawning and rearing habitat available to salmon and steelhead populations originating throughout California, Oregon, and Washington. As a result of these habitat losses, significant long-term reductions in steelhead populations have occurred throughout the Region over the last 20-50 years. Although efforts to rehabilitate freshwater habitat are expected to occur in some areas, and there is an increased recognition that such efforts are necessary, it is unlikely that significant improvements in either habitat availability or quality will occur in the next 35 years since many activities that have resulted in historical degradation or loss of critical habitat are likely to continue in the future (e.g., hydroelectric plant operations, water diversions, etc.). Since the abundance of steelhead runs and populations are, at least in part, related to the productive capacity of spawning and rearing habitat, habitat changes over the next 35 years would be expected to influence the abundance of steelhead populations as they have in the past. Based on projections made by the PFMC (1981), habitat availability for anadromous fish (i.e., salmon and steelhead) in California, Oregon, and Washington, with or without rehabilitation efforts, is expected to remain relatively unchanged in the near future (i.e., 10-20 years), except for marginal improvements in rivers supporting some stocks.

Although marginal improvement in the availability of habitat for some stocks is expected in the future, the overall productive capacity of freshwater spawning and rearing habitat for steelhead is not expected to change significantly over the next 35 years. As a result, long-term changes in Pacific Region steelhead populations over the next 35 years are not likely to be attributable to reduced habitat availability.

The principal impacting agents that could potentially impact migratory steelhead stocks over the next 35 years as a result of existing and approved oil/gas activities are discussed under Pacific Salmon (see Section IV.D.2.a.(2)). Based on available information such impacts as a result of seismic surveys are expected to be localized and short-term, lasting on the order of several hours to several days at most. The seasonal abundance of migratory steelhead in southern California is relatively low compared to other areas in the Pacific Region; however, some steelhead may occur in those areas where seismic survey activities will occur over the next 35 years. Migratory steelhead are expected to be widely dispersed while in southern California; thus only some of the fish transiting the area are likely to be within the influence of, or affected by, acoustic discharges. Based on existing information, acoustic discharges from existing and future seismic survey activity may cause localized and temporary (hours to days) changes in the distribution of steelhead migrating through the Santa Maria Basin and Santa Barbara Channel; however, such activities are not expected to cause any discernible lethal impacts that would reduce the abundance of steelhead populations.

Drilling discharges expected to occur in southern California from exploratory, delineation, and production wells over the next 35 years are discussed under Pacific Salmon in Section IV.D.2.a.(2).

The abundance of migratory steelhead in southern California is very low compared to other areas further north in the Pacific Region; however, some steelhead can be expected to occur seasonally in those areas (i.e., the Santa Maria Basin and Santa Barbara Channel) where drill muds and cuttings will be discharged over the next 35 years. Migrating steelhead are expected to be widely dispersed while in southern California; thus only some of the fish transiting the area are likely to come into contact with these materials since they will be discharged intermittently and are expected to be diluted rapidly.

Exposure to these discharges is also expected to occur for only short periods of time. Temporary exposure of migrating steelhead to these drilling discharges may result in localized and short-term (minutes to hours) changes in distribution if fish avoid the discharge plume; however, such discharges are

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not expected to cause any discernible lethal impacts that would result in a decline in the abundance of steelhead populations.

A total of 21 oil spills are estimated to occur over the next 35 years as a result of oil and gas activities in southern California, tanker activity in the Gulf of Alaska (i.e., TAPS oil production), and offshore Washington, Oregon, central California, and southern California. (See discussion under Pacific Salmon (Section IV.D.2.a(2).)

The life-history stages of steelhead that are expected to be most sensitive to oil exposure are the same as those discussed for Pacific salmon (see Section IV.D.2.a.(2)). For these reasons, steelhead stocks originating in the Pacific Region are only expected to be affected by oil spills that occur in those areas where steelhead producing rivers are located. Conversely, oil spills that occur in the Gulf of Alaska or southern California are not expected to reduce steelhead stocks originating in Washington, Oregon, or California since the life-history stages of these stocks that are most sensitive to oil spills typically do not occur in these areas.

Pacific Region steelhead populations are expected to be affected by oil spills offshore Washington, Oregon, and central California from existing activities, as discussed under Pacific Salmon (see Section IV.D.2.a(2)). These oil spills are assumed to contact and affect sensitive life-history stages (i.e., smolts, juveniles and/or prespawning adults) of steelhead occurring in nearshore waters near productive steelhead rivers since these life stages are expected to occur throughout much of the year in many areas.

As discussed previously, these oil spills are expected to reduce steelhead populations by causing direct mortality of outmigrating smolts, by reducing the survivorship of outmigrating smolts, or by reducing the spawning escapement of adult steelhead through "straying" or delays in spawning runs. This reduction in smolt production or spawning escapement could result in a future decline in the abundance of returning spawners. The magnitude of this decline is expected to be highly variable, but is expected to be related to the degree of oil contamination that occurs, the duration of the contamination, the coastal area and number of productive river systems affected, and the proportion of total smolt production and/or the spawning adult population that is affected.

The impacts to steelhead from individual oil spills are generally expected to be localized unless a large number of productive rivers and streams, or a major river system (e.g., Eel or Klamath Rivers) is affected. In the hypothetical case where two oil spills occur in a single year (e.g., Washington and central California) and sensitive life-history stages are affected, the overall impacts to salmon are expected to be greater since a larger area and more steelhead populations will likely be affected. Since steelhead produced in any 1 year generally spend from 2-4 years (depending upon the stock) maturing before returning to spawn, their contribution to future spawning runs will also be largely spread over a 2- to 4-year period. For this reason, the decline in abundance of future spawning runs or populations resulting from the impacts of one or even two oil spills in different areas is expected to be spread primarily over a period of 2-4 years following the spill event. Both the magnitude and duration of impacts to salmon populations from oil spills, however, are likely to be somewhat buffered, since individual spawning runs or populations in any given year are generally comprised of fish produced over several preceding years (i.e, several year classes), and not just the year class affected by a prior oil spill. Since individual oil spills in Washington, Oregon, and central California from tanker activity are estimated to occur at intervals of 10-12 years over the next 35 years, and the duration of impacts from an individual oil spill is estimated to be 2-4 years, the long-term impacts of multiple, widely-spaced oil spills on steelhead populations are not expected to be overlapping or cumulative.

The principal nonoil-related factors or activities that may affect migratory steelhead stocks with the addition of the current and future 5-year programs over the next 35 years are the same as those discussed above.

Long-term cumulative impacts may occur to migratory steelhead stocks originating in the Pacific Region as a result of both existing, approved, and future OCS activities, as well as existing and future non-OCS oil-related activities. The principal agents that could potentially affect migratory steelhead stocks originating in the Pacific Region over the next 35 years as a result of existing, approved, and future oil/gas activities include seismic survey activities and drilling discharges (from exploration and development) from oil- and gas-related activities throughout the Pacific Region, oil spills resulting from development activities (platforms and pipelines), and oil spills from tanker (i.e., TAPS and foreign imports) activity throughout the Pacific Region and the Gulf of Alaska.

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Seismic survey activities in the Pacific Region and the Gulf of Alaska as the result of the addition of the current and future 5-year programs are discussed under Pacific Salmon (see Section IV.D.2.a.(2)). Migrating juvenile or adult steelhead originating from rivers located primarily in Washington, Oregon, and northern and central California are expected to occur in offshore areas in the vicinity of seismic surveys operations throughout the Pacific Region and the Gulf of Alaska over the next 35 years. As discussed for the hypothetical case from existing activities, surveys harm few, if any, fish and result in little more than localized and temporary changes in distribution of localized fish populations. As a result, therefore, oil and gas seismic surveys throughout the Pacific Region and the Gulf of Alaska over the next 35 years may cause localized and temporary (hours to days) changes in the distribution of some migrating steelhead, but are not expected to cause any discernible lethal impacts that would reduce the abundance of steelhead populations.

An increase in drilling discharges (i.e., drill muds and cuttings) are expected to occur in the Gulf of Alaska and throughout the Pacific Region from exploratory, delineation, and production wells drilled over the next 35 years with the addition of the current and future 5-year programs (see discussion under Pacific Salmon IV.D.2.a(2)), with the vast majority to be drilled in southern California. Although migratory steelhead are expected to pass through areas where drill muds and cuttings are discharged over the next 35 years, only some of the fish passing through an area with active drilling are likely to come into contact with these materials since fish are expected to be relatively dispersed, discharges will occur intermittently, and discharges are expected to be diluted rapidly. Exposure to these discharges, if at all, is also expected to occur for only short periods of time. As discussed above, the available literature indicates that these types of drilling discharges generally result in no short-term or acutely lethal impact to marine organisms, including fish. Thus, temporary exposure of migratory steelhead to these drilling discharges may result in localized and short-term (minutes to hours) changes in distribution if some fish avoid the discharge plume; however, these discharges are not expected to cause any discernible lethal impacts that would reduce the abundance of steelhead populations.

With the addition of the current and future 5-year programs a total of 29 oil spills are estimated to occur over the next 35 years as a result of oil and gas activities in California, tanker activity (ie., TAPS and foreign imports) in the Gulf of Alaska and offshore Washington, Oregon, and California (see discussion under Pacific Salmon IV.D.2.a(2)). Only eleven of these oil spills, primarily occurring in southern California (a total of seven oil spills), are estimated to occur from platforms or pipelines as a result of OCS activities. The remainder of these oil spills are estimated to occur as a result of tanker activity. As discussed for existing oil and gas activities, the life-history stages of steelhead that are most sensitive to oil exposure are expected to be outmigrating smolts, nearshore feeding juveniles, and adults that are preparing to ascend their home rivers to spawn. Thus, as for the hypothetical case analyzed above, steelhead stocks originating in the Pacific Region are expected to be affected only by oil spills that occur in those areas where steelhead producing rivers are located.

Conversely, oil spills that occur in the Gulf of Alaska and southern California are not expected to affect steelhead stocks originating in Washington, Oregon, or California, since few, if any, of the life-history stages from these stocks that are most sensitive to oil spills typically occur in these areas. With the addition of the current and future 5-year programs, steelhead populations are expected to be affected by eight oil spills occurring offshore Washington, Oregon, northern California, and central California over the next 35 years (see Table IV.B.4-2).

The assumptions used for this analysis is discussed in detail under Pacific Salmon (IV.D.2.a(2)). Only two spills, one each in northern and central California, are estimated to occur from platforms. The remainder of these oil spills are expected to occur as a result of TAPS or foreign import tanker activity. It is assumed that two of these oil spills will occur in 1 year over the next 35 years (assumed to be in Washington and central California); however, in general these oil spills are assumed to be distributed evenly over the next 35 years and among seasons. Thus, oil spills are generally expected to occur in different seasons offshore Washington and/or Oregon once every 12 years, offshore northern California once every 17-18 years, and offshore central California once every 9 years, with two oil spills occurring in two different areas (assumed to be Washington and central California) in 1 year over this 35-year period.

These oil spills are assumed to contact and affect sensitive life stages (i.e., smolts, juveniles, and/or prespawning adults) of steelhead occurring in estuaries or in nearshore waters adjacent to productive steelhead rivers, and are, therefore, expected to impact steelhead populations by causing direct mortality of outmigrating smolts, by reducing the survivorship of outmigrating smolts, or by reducing the spawning

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escapement of adults through "straying" or delays in spawning runs. This reduction in smolt production or spawning escapement could result in a future decline in the abundance of returning spawners for the stock or population affected.

The magnitude of this decline is likely to be highly variable, but it is expected to be related to the degree of oil contamination that occurs, the duration of the contamination, the coastal area and number of productive river systems affected, and the proportion of total smolt production and/or the spawning adult population that is affected. The impacts to steelhead from individual oil spills are generally expected to be localized unless a large number of productive rivers and streams, or a major river system (e.g., Eel or Klamath River) is affected. In the case where two oil spills in different areas occur in a single year (e.g., Washington and central California), and sensitive life-history stages are contacted, the impacts to steelhead are expected to be greater since a larger area and more steelhead stocks are likely to be affected. Because steelhead produced in any one year spend from 2-4 years (depending upon the stock) maturing before returning to spawn, their contribution to future spawning runs will also be primarily spread over a 1- to 5-year period. For this reason, the decline in abundance of future spawning runs or populations resulting from the impacts of one or two oil spills in any given year is estimated to be spread primarily over a period of from 1-5 years following the oil spill event.

Both the magnitude and duration of impacts to steelhead populations from oil spills, however, are likely to be somewhat buffered, since individual spawning runs or populations in any given year are generally comprised of fish produced over several preceding years (i.e, several year classes), and not just the year class affected by a prior oil spill. Since individual oil spills in Washington, Oregon, northern California and central California from oil and gas production and tanker activity are estimated to occur at intervals of 9-17 years apart over the next 35 years, and the duration of impacts from individual spills are estimated to occur primarily for a period of 2-4 years, the long-term impacts of multiple spills on steelhead populations in the Pacific Region are not expected to be overlapping or cumulative.

CONCLUSION: The long-term cumulative impacts to some migratory steelhead populations originating in the Pacific Region are expected to be moderate, as a result of the combined impacts of overharvesting by commercial and sport fishermen, and oil spills resulting primarily from tanker activity.

d. Pacific Whiting

Analysis of fishery catch data from 1985-86 and 1986 research fishing survey data from the California Department of Fish and Game suggest the whiting subpopulation and fishery is presently dominated by young fish from the 1984 and 1986 year classes. The 1984 year class was evidently very large, and represented nearly 60 percent of the estimated population abundance and 37 percent of the estimated population biomass in 1987 (PFMC, 1987). The strength of these year classes suggests that at least over the next several years, the whiting subpopulation centered off California, Oregon, and Washington will be at a relatively high level of abundance.

The principal nonoil-related factors or activities expected to affect the whiting subpopulation over the next 35 years are natural fluctuations in abundance resulting from fluctuating environmental conditions and variable year class strength and adult mortality resulting from directed domestic and foreign commercial fishing pressure on the subpopulation.

According to MBC (1986) fish scale deposits in the southern California Bight suggest that the Pacific whiting subpopulation located offshore California has undergone considerable natural fluctuations in abundance over the past two hundred years. In the early 1900's, for example, the whiting population was evidently an order of magnitude larger than at present based on this fish scale data. The Pacific whiting is a long-lived species (up to 17 years, but typically 8-12 years), with several year classes contributing to the adult population and the commercial fishery at any given time. However, year class strength of whiting is highly variable and strong year classes with successful recruitment have been directly correlated to the presence of favorable environmental conditions at the time of spawning and early larval development (PFMC, 1987).

For example, research fishing surveys conducted by the California Department of Game over the past 20 years indicate that strong year classes of whiting were produced in 1967, 1970, 1973, 1977, 1980, 1984, and 1986 (PFMC, 1987). In contrast, the same data indicate that weak year classes occurred in 1981 and 1983. Historical fishery catch data suggest that these dominant year classes of whiting are the major determinants of population abundance and support the commercial fishery. As discussed above, the strong year classes of 1984 and 1986 are currently dominating the whiting subpopulation and commercial

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fishery. Since several year classes (up to 10 or more) contribute to the adult whiting subpopulation occurring offshore California, Oregon, and Washington, weak year classes could potentially reduce whiting subpopulation abundance for several years (up to 10 or more).

The impacts of weak year classes on the whiting subpopulation abundance, however, are expected to be buffered by the large number of year classes that contribute to the adult subpopulation, as well as the periodic strong year classes that have tended to dominate the subpopulation in the last 20 years. Assuming that strong year classes continue to occur every 3-4 years over the next 35 years as they have in the past 20 years, then the impacts on whiting subpopulation abundance from occasional weak year classes are unlikely to persist for longer than 3-4 years.

Domestic and foreign commercial fishing pressure is expected to continue on the Pacific whiting subpopulation offshore California, Oregon, and Washington over the next 35 years. However, the impact of this commercial fishing pressure on whiting subpopulation abundance is difficult to estimate. As discussed in section IV.C., the annual commercial catch of whiting has averaged approximately 125,000 mt over the last 20 years, but has generally been decreasing since 1980. The subpopulation is considered healthy at present, and if strong year classes are assumed to occur periodically (i.e., ever 3-4 years), then it is likely that annual catches of whiting over the next 35 years will generally fall within the range observed in the past 20 years.

As discussed above, the commercial fishery for whiting and the magnitude of the commercial harvest is strongly influenced by the presence of strong year classes in the harvestable population. Since strong year classes largely support the commercial fishery, commercial fishing pressure that overharvested one or more strong year classes that dominated the subpopulation could potentially reduce the abundance of the adult whiting subpopulation off California, Oregon, and Washington. However, since strong year classes are expected every 3-4 years based on past records, it is expected that recovery of the subpopulation would occur within a period of 3-4 years.

Long-term cumulative impacts could potentially occur to the Pacific whiting subpopulation occurring offshore California, Oregon, and Washington as a result of both existing and approved OCS and non-OCS oil-related activities. The principal agents that could potentially affect the whiting subpopulation over the next 35 years as a result of existing and approved oil/gas activities under Pacific Salmon (see Section IV.D.2.a.(2)). Based on available information from these studies, impacts as the result of seismic surveys are expected to be very localized and short-term, lasting on the order of several hours to several days at most.

Recent controlled field studies concerning the impacts of airgun discharges on the eggs and larvae of fish and shellfish indicate that direct mortality is relatively small or nonexistent, and if mortality does occur it is only when these stages are in very close proximity (i.e., 1-3 m) to the airgun source (Tracor Applied Sciences, 1987; Dalen and Knutsen, 1986; Battelle and BBN, 1989). The egg, larval, juvenile, and adult life-history stages of whiting are expected to occur throughout much of the year in those portions of southern California where seismic survey activities will occur over the next 35 years.

Although some whiting life-history stages are expected to occur in the general vicinity of where these surveys will be conducted, these stages are generally most abundant at depths of 50-100 m, and are widely dispersed throughout the southern California area. Based on the broad depth and geographic distribution of whiting life-history stages throughout southern California and the available information concerning the impacts of acoustic discharges on fish, seismic survey activity may cause localized and temporary (hours to days) changes in the distribution of juvenile or adult whiting occurring in the Santa Maria Basin and Santa Barbara Channel; however, such activities are not expected to result in any discernible lethal impacts to early life-history stages (i.e., eggs and larvae) that would reduce the abundance of the whiting subpopulation off California, Oregon, and Washington.

Drilling discharges (i.e., drill muds and cuttings) which are expected to occur in southern California from exploratory, delineation, and production wells over the next 35 years are discussed under Pacific Salmon in Section IV.D.2.a(2). Neff (1985) reviewed substantial literature that indicated drilling muds or fluids are rapidly diluted within several meters of a discharge location and that these discharges generally result in no short-term or acutely lethal impact to marine organisms. The egg, larval, juvenile, and adult life-history stages of whiting are expected to occur throughout much of the year in those portions of southern California where drill muds and cuttings will be discharged over the next 35 years. Although some whiting life-history stages may occur in the general vicinity of where these surveys will be

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conducted, these stages are widely dispersed throughout the southern California area and are generally most abundant at depths of 50-100 m. Based on the broad depth and geographic distribution of all whiting life-history stages throughout southern California, relatively few, if any, individuals of any life-history stage are expected to come into contact with drilling discharges.

If exposure to drilling discharges does occur, however, it is expected to be only for short periods of time since discharges are likely to occur intermittently and be diluted rapidly. Temporary exposure of whiting life-history stages to these drilling discharges may result in localized and short-term (minutes to hours) changes in distribution of juveniles or adults if fish avoid the discharge plume; however, such discharges are not expected to result in any discernible lethal impacts on the early life-history stages of whiting that would result in a decline in the abundance of the whiting subpopulation occurring off California, Oregon, and Washington.

A total of 21 oil spills are estimated to occur over the next 35 years as a result of oil and gas activities in southern California, tanker activity in the Gulf of Alaska (i.e., transportation of TAPS oil production), and offshore Washington, Oregon, central California, and southern California see discussion under Pacific Salmon (Section IV.D.2.a(2)).

The egg and larval stages of whiting, rather than juveniles or adults, are expected to be most sensitive and potentially vulnerable to oil spills. Based on the existing literature (MBC and SAI, 1983), these stages could potentially suffer direct mortality, as well as sublethal impacts on feeding and growth, as a result of oil exposure. If sufficient egg and larval mortality were to occur as a result of exposure to an oil spill, then it is possible that eventual recruitment of juveniles or adults could also be reduced. These early life-history stages are most abundant in southern California, and to a lesser extent in central California, where whiting spawn in the fall and winter. Relatively few, if any, of these early life-history stages, however, are likely to be contacted by oil spills since they are widely distributed throughout southern California, occur primarily offshore rather than in nearshore waters, and are most abundant at depths of approximately 50 m.

Pelagic juvenile or adult whiting occur in offshore waters throughout much of the Pacific Region; however, they are expected to avoid oil spills, or simply not come into contact with spilled oil, since they normally occur at depths well below the water surface (i.e., 90-100 m) and are widely dispersed offshore. For these reasons, oil- and gas-related activities occurring offshore California, Oregon, or Washington from existing projects and proposals are not expected to affect the whiting subpopulation occurring in this region.

Long-term cumulative impacts may occur to the Pacific whiting subpopulation occurring offshore California, Oregon, and Washington as a result of the addition of the current and future 5-year programs to existing and future nonoil-related factors or activities. The principal nonoil-related factors or activities expected to affect the whiting subpopulation over the next 35 years are the same as those discussed above. The impacts of these factors or activities on the whiting subpopulation with the addition of the current and future 5-year programs are expected to be the same as those discussed above for existing activities.

Long-term cumulative impacts could potentially occur to the Pacific whiting subpopulation occurring offshore California, Oregon, and Washington as a result of both existing, approved, and future OCS and Non-OCS oil related activities. The principal agents that could potentially affect the whiting subpopulation over the next 35 years as a result of existing, approved and future oil/gas activities include seismic survey activities and drilling discharges (from exploration and development) from OCS-related activities throughout the Pacific Region, platform and pipeline oil spills from OCS development activities in California, and oil spills from tanker (i.e., TAPS and foreign imports) activity throughout the Pacific Region and the Gulf of Alaska.

Seismic survey activities in the Pacific Region and the Gulf of Alaska as the result of the addition of the current and future 5-year programs are discussed under Pacific Salmon (see Section IV.D.2.a.(2)). The egg, larval, juvenile, and adult life-history stages of whiting are expected to occur throughout much of the year in those areas where seismic survey activities will occur over the next 35 years. Although whiting life-history stages are expected to occur in the general area where these surveys will be conducted, these stages are widely dispersed throughout the Region and are generally most abundant at depths of 50-100 m. As discussed under existing activities seismic surveys harm few, if any, juvenile or adult fish, result in little more than localized and temporary changes in the distribution of local fish populations, and

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cause relatively little or no direct mortality of the egg or larval stages of fish and shellfish even when these stages are in very close proximity (i.e. 1-3 m) to an airgun source.

Based on the broad depth and geographic distribution of whiting life-history stages throughout the Region and the available information concerning the impacts of acoustic discharges on fish, seismic survey activity associated with the current and future 5-year programs may cause localized and temporary (hours to days) changes in the distribution of juvenile or adult whiting occurring in the vicinity of some surveys; however, such activities are not expected to result in any discernible lethal impacts to adult or early life-history stages (i.e., eggs and larvae) that would reduce the abundance of the whiting subpopulation off California, Oregon, and Washington.

Increase in drilling discharges (i.e., drill muds and cuttings) are expected to occur in the Gulf of Alaska and throughout the Pacific Region from exploratory, delineation, and production wells over the next 35 years with the addition of the current and future 5-year programs with the vast majority to be drilled in the southern California area. Based on the broad depth and geographic distribution of all whiting life-history stages offshore California, relatively few, if any, individuals of any life-history stage are expected to come into contact with drilling discharges. If exposure to drilling discharges does occur, however, it is expected to be only for short periods of time since discharges are likely to occur intermittently and be diluted rapidly. As discussed above, the available literature indicates that these types of drilling discharges generally result in no short-term or acutely lethal impact to marine organisms. Thus, temporary exposure of juvenile and adult whiting to drilling discharges as a result of the addition of the current and future 5-year programs may result in localized and short-term (minutes to hours) changes in distribution if fish avoid the discharge plume; however, such discharges are not expected to result in any discernible lethal impacts on the early life-history stages of whiting that would result in a decline in the abundance of the whiting subpopulation occurring off California, Oregon, and Washington.

With the addition of the current and future 5-year programs, a total of 29 oil spills are estimated to occur over the next 35 years as a result of OCS activities in California, tanker activity in the Gulf of Alaska (i.e., transportation of TAPS oil production), and tanker activity (i.e., TAPS and foreign imports) offshore Washington, Oregon, central California, and southern California. Eleven of these oil spills, primarily in southern California (a total of seven oil spills), are estimated to occur from platforms or pipelines as a result of OCS activities. The remainder of these oil spills are estimated to occur as a result of tanker activity. As discussed for existing oil and gas activities, the egg and larval stages of whiting, rather than juveniles or adults, are expected to be most sensitive and potentially vulnerable to oil spills. Based on the existing literature (MBC and SAI, 1983), these stages could potentially suffer direct mortality, as well as sublethal impacts on feeding and growth, as a result of oil exposure. If sufficient egg and larval mortality were to occur as a result of exposure to an oil spill, then it is possible that eventual recruitment of juveniles or adults could also be reduced.

These early life-history stages are most abundant in southern California, and to a lesser extent in central California, where whiting spawn in the fall and winter. Relatively few, if any, of these early life-history stages, however, are likely to be contacted by oil spills in southern California since they are widely distributed throughout southern and central California, occur primarily offshore rather than in nearshore waters, and are most abundant at depths of approximately 50 m. Pelagic juvenile or adult whiting occur in offshore waters throughout much of the Pacific Region; however, they are expected to avoid oil spills, or simply not come into contact with spilled oil, since they normally occur at depths well below the water surface (i.e., 90-100 m) and are widely dispersed offshore. For these reasons, oil spills occurring offshore California, Oregon, or Washington are not expected to affect the whiting subpopulation occurring in this region.

CONCLUSION: The long-term cumulative impacts to the Pacific whiting subpopulation centered offshore California, Oregon, and Washington are expected to be moderate, as a result of the combined impacts of commercial overfishing and natural fluctuations in subpopulation abundance due to weak year classes.

E. Alternatives to Simultaneous Development

1. Introduction

The court's remand was to provide for "further consideration" of the cumulative impacts on migratory species and for the Secretary to make "any revisions in the 5-year program that consideration may warrant." The court suggested the Secretary examine alternatives to simultaneous development that would mitigate any cumulative impacts on migratory species. The following alternatives were designed explicitly to mitigate, if necessary, the potential impacts to migratory species caused by the 1987 Program. The analysis in Section IV.D. of this document distinguishes impacts to migratory species from existing OCS and non-OCS activities from the impacts associated with the current and future 5-year programs. Because of this distinction, the analysis presented in Section IV.D. also serves as the analytical basis for Alternatives II and III. This section provides a summary of the analysis in IV.D as it relates to Alternatives II and III.

2. Alternative II - Defer Leasing in One or More Planning Areas

This alternative would defer leasing in one or more planning areas in the Alaska and Pacific Regions. The purpose for deferral is to avoid the simultaneous oil and gas development activities that were identified in Section IV.D. as causing impacts on one or more migratory species. It is assumed for this analysis that any planning area deferred under this alternative would also be deferred from leasing under future 5-year programs. Adopting this alternative eliminates the possibility that simultaneous development could occur in the Pacific and Alaska Regions as a result of the 5-year program.

The analysis in Section IV.D. provides the basis for identifying migratory species that are expected to be substantively affected by the 5-year program. The analysis that follows further considers whether deferral of one or more planning areas from future leasing would reduce the cumulative impact by one level or more.

a. Marine Mammals

With the assumption of simultaneous development along the migratory routes of the various species of cetaceans, the overall cumulative impacts range from very low to moderate. In many instances the cetaceans are experiencing various levels of impacts from existing activities (see Section IV.D.1.). However, when the overall expected level of impacts from all sources is compared with the level of impacts from existing impact producing factors or agents (see Section IV.D.1.), these levels did not appreciably change. No significant increase in impacts can be attributed to the current or future 5-year programs. Therefore, cetaceans in general are expected to experience the same level of impact with the addition of the current and future 5-year programs to the existing environment.

The overall cumulative impacts to pinnipeds along their migratory routes range from very low to high. With the exception of the northern fur seal, these impact levels are comparable to those which are currently being experienced as a result of existing activities. No significant increase in impacts can be attributed to the current or future 5-year programs. Therefore, this alternative will not reduce the overall level of impacts to marine mammals, except for the northern fur seal.

The northern fur seals which comprise the Pribilof Island population have been declining since the 1950's; reasons for this decline are unclear. Existing impact producing factors or agents (OCS and non-OCS) are currently causing a moderate level of impact to this species (see Section IV.D.1.c.). Based on the analysis of multiple oil spills as a consequence of the addition of the current and future 5-year programs the expected level of the overall cumulative impacts are high.

This analysis was based on the assumption that an oil spill contacted the northern fur seals while concentrated in the vicinity of the Pribilof Islands during the summer or fall and during peak passage through Unimak Pass. In other locations or seasons, the northern fur seals are widely dispersed in the pelagic environment where multiple oil spills are not likely to contact significantly large numbers of seals. In such cases, impacts above the moderate level are not expected from the existing environment. It was determined based on the analysis in Section IV.D.1.c. that the contributing factor to the increased likelihood of multiple oil spills contacting the northern fur seals is from potential oil and gas development in the St. George Basin.

The deferral of the development and transportation of oil resources within the St. George Planning Area during this and future 5-year programs would reduce the risk of contact to this localized population during periods of concentration. The deferral of the St. George Planning Area from future leasing would also result in the elimination of all potential impacts from the current and future leasing programs on all components of the physical, biological, and socioeconomic environment within the planning area. Impacts to these resources which would be avoided by the deferral of this planning area are analyzed in Section IV.B.16. (pages IV.B.16-1 to IV.B.16-3) of the FEIS.

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b. Coastal and Marine Birds

A comparison of the cumulative effects on coastal and marine birds from existing and proposed activities and those associated with the current and future 5-year programs indicate there is no appreciable change in impact levels. The overall cumulative impacts range from low to moderate. To some extent, these impacts may be increased above existing levels from the simultaneous development of the planning areas along the species migratory route. However, these increases did not raise the expected overall impact levels. The deferral of one or more planning areas would not reduce the level of cumulative impact with the addition of the current or future 5-year programs.

c. Fish Resources

The overall cumulative impact to fish resources within the Alaska and Pacific Regions range from very low to very high depending upon the species. Levels of impacts related to existing and proposed activities along the migratory range of these species are discussed in Section IV.D.2. Although the simultaneous development of the hydrocarbon resources in the planning areas increased the level of oil and gas activities along the migratory routes, this increase did not elevate any of the impacts to a higher level. In all instances, the cumulative impact level for each species remained the same even with the addition of the activities associated with the current and future 5-year programs.

CONCLUSION: In general, the deferral of one or more planning areas in the Alaska and Pacific Regions would not reduce the level of cumulative impacts to the various migratory species (marine mammals, fish resources, and coastal and marine birds) with the exception of the northern fur seal. The deferral of the St. George Basin Planning Area from the current and future 5-year programs would reduce the risk of multiple oil spills contacting to the northern fur seal during periods of concentration in the Pribilof Island - Unimak Pass area. Therefore, this alternative would reduce the inpact to the nothern fur seal from hight to moderate.

3. Alternative III - No Action

The evaluation of a "no action" alternative is required, however, by the regulations implementing NEPA (40 CFR 1502.14(d)). For the purpose of this analysis only, this alternative assumes that the remaining lease sales within the Alaska and Pacific Regions will be cancelled for the remainder of the period covered by the 5-year program approved by the Secretary on July 2, 1987. This alternative would constitute the most extreme level of mitigation to eliminate simultaneous development.

Under this alternative the only Federal oil and gas activities in the Pacific and Alaska Regions would be from previously leased areas. A comparison of the effects from existing activities and the current and future 5-year programs indicates that the 5-year programs does not increase impacts to migratory species above impact levels from existing activities, with the exception of northern fur seals.

Existing impact producing factors or agents (OCS and non-OCS) are currently causing a moderate level of impact to the northern fur seal (see Section IV.D.1.c.). Based on the analysis of multiple oil spills as a consequence of the addition of the current and future 5-year programs the expected level of the overall cumulative impacts are high. It was determined based on the analysis in Section IV.D.1.c. that the contributing factor to the increased likelihood of multiple oil spills contacting the northern fur seals is from potential oil and gas development in the St. George Basin.

The deferral of the development and transportation of oil resources within the St. George Planning Area during this and future 5-year programs would reduce the risk of contact to this localized population during periods of concentration. The deferral of the St. George Planning Area from future leasing would also result in the elimination of all potential impacts from the current and future leasing programs on all components of the physical, biological, and socioeconomic environment within the planning area. Impacts to these resources which would be avoided by the deferral of this planning area are analyzed in Section IV.B.16. (pages IV.B.16-1 to IV.B.16-3) of the FEIS.

The deferral of leasing in these planning areas would also result in the elimination of all potential impacts as a result of the exploration, development, and production activities on all components of the physical, biological, and socioeconomic environment within the planning area. Impacts to these resources which would be avoided by the deferral of these planning areas are analyzed in Section IV.B.of the FEIS.

CONCLUSION: In general, the deferral of one or more planning areas in the Alaska and Pacific Regions would not reduce the level of cumulative impacts to the various migratory species (marine mammals, fish resources, and coastal and marine birds) with the exception of the northern fur seal. The deferral of the St. George Basin Planning Area would reduce the risk of multiple oil spills contacting to the northern fur seal during periods of concentration in the Pribilof Island - Unimak Pass area for the current program.

CHAPTER V

CONSULTATION AND COORDINATION

V. CONSULTATION AND COORDINATION

The SEIS tiers directly from the FEIS; therefore, issues and concerns presented in the CONSULTATION AND COORDINATION Section of the FEIS which pertain to the preparation of the SEIS were taken into consideration during its development.

Information used in the preparation of the SEIS was obtained from a number of sources. Sale specific documents prepared for individual lease sales were an important source of data on the affected environment, the species which have been of concern in the past, the factors which may affect those species, how those species are affected by various offshore activities, and how the species have been affected in the past.

Additional information was obtained from contacts established within the academic community, Federal Agencies, State and local governments, and the oil and gas industry.

In developing the scope of the SEIS, MMS focused on the inadequacies identified by the court. The court's guidelines were taken into consideration during the development of the scope of the SEIS, including suggestion that the Secretary could;

a)examine cumulative impacts of simultaneous inter-regional Outer Continental Shelf (OCS) development in a single, coherent section rather than fragment his analysis by area;

b)identify the various migratory species and the full range of their routes of migration, describe the OCS and non-OCS activities along those routes, and state the synergistic effects of those activities on the migratory species;

c)support such a presentation with references to scientific studies and other materials so that a decisionmaker would have ready access to the information underlying the Secretary's findings and conclusions;

d)consider alternatives to the proposed action, examine alternatives to simultaneous development that would mitigate any synergistic impacts on migratory species; and

e)set out the pros and cons of various alternatives and explain his reasons for adopting whatever course of action he decided upon.

The MMS also consulted with EPA on January 17, 1989 to discuss concerns expressed by EPA in their May 9, 1986 letter on the DEIS for the Proposed 5-Year Program. The suggestions outlined by the court and the concerns expressed by EPA were taken into consideration during the preparation of the SEIS.

CHAPTER VI

REFERENCES

VI. REFERENCES

Only those reference which were not cited in the FEIS for the Proposed 5-Year Program are listed below. The remaining references are contained in Chapter VI. (pages VI-1 to VI-65) of the FEIS.

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CHAPTER VII

PRINCIPAL PREPARERS

VII. PRINCIPAL PREPARERS

ALASKA REGION

Joel Hubbard	Wildlife Biologist
Gail Irvine	Fisheries Biologist
Bob Weinhold	Fisheries Biologist
Gray Wheeler	Endangered Species Specialist

PACIFIC REGION

Mary Elaine Dunaway	Environmental Specialist
Rey Farve	Wildlife Biologist
Craig Weingart	Fisheries Biologist

WASHINGTON OFFICE

Carol Fairfield	Biological Oceanographer
Vanessa Grable	Secretary, Branch of Environmental Evaluation
Ken Havran	Environmental Specialist
Jacob Lehman	Environmental Specialist
Debra Purvis	Environmental Specialist
Robert Middleton	Marine Biologist
Richard Wildermann	Chief, Branch of Environmental Evaluation

CHAPTER VII

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APPENDIX A

IMPACT LEVEL DEFINITIONS

APPENDIX A

FISH RESOURCES

VERY HIGH—	A population declines resulting in a change in the distribution and/or abundance of the species. The expected duration of the effects is more than three generations* or 10 or more years.
HIGH —	A population declines resulting in a change in the distribution and/or abundance of the species. The expected duration of the effects is two or three generations or 6 to 9 years.
MODERATE —	A population declines resulting in a change in the distribution and/or abundance of the species. The expected duration of the effects is less than one generation or 3 to 5 years.
LOW—	A population declines resulting in a change in the distribution and/or abundance of the species. The expected duration of the effects is less than one generation or 1 to 3 years.
VERY LOW—	No discernible lethal effects, but individuals experience sublethal effects which cause reduced biogenic activity or reduced metabolic functions. Organisms would recover to pre-impact condition within one generation or 1 to 3 years.

*A generation is the term of years accepted as the average period between the birth of the parents and the birth of their offspring (Random House Dictionary, 1982).

ENDANGERED AND THREATENED SPECIES

VERY HIGH—	A population declines resulting in a change in the distribution and/or a bundance of the species. The expected duration of the effects is more than three generations* or 10 years or more.
HIGH—	A population declines resulting in a change in the distribution and/or a bundance of the species. The expected duration is two or three generations or 6 to 9 years.
MODERATE—	A population declines resulting in a change in the distribution and/or a bundance of the species. The expected duration of the effects is less than one generation or 3 to 5 years.
LOW—	A population declines resulting in a change in the distribution and/or a bundance of the species. The expected duration of the effects is less than one generation or 1 to 3 years.
VERY LOW—	No discernible lethal effects, but individuals experience sublethal effects which cause reduced biogenic activity or reduced metabolic functions. Organisms would recover to pre-impact condition within one generation or 1 to 3 years.

*A generation is the term of years accepted as the average period between the birth of the parents and the birth of their offspring (Random House Dictionary, 1982).

MARINE MAMMALS AND BIRDS (NONENDANGERED SPECIES)

VERY HIGH—	A population declines resulting in a change in the distribution and/or a bundance of the species. The expected duration of the effects is more than three generations* or 10 years or more.
HIGH—	A population declines resulting in a change in the distribution and/or a bundance of the species. The expected duration of the effects is two or three generations or 6 to 9 years.
MODERATE —	A population declines resulting in a change in the distribution and/or abundance of the species. The expected duration of the effects is less than one generation or 3 to 5 years.
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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

March 3, 1849

Minerals Management Service

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